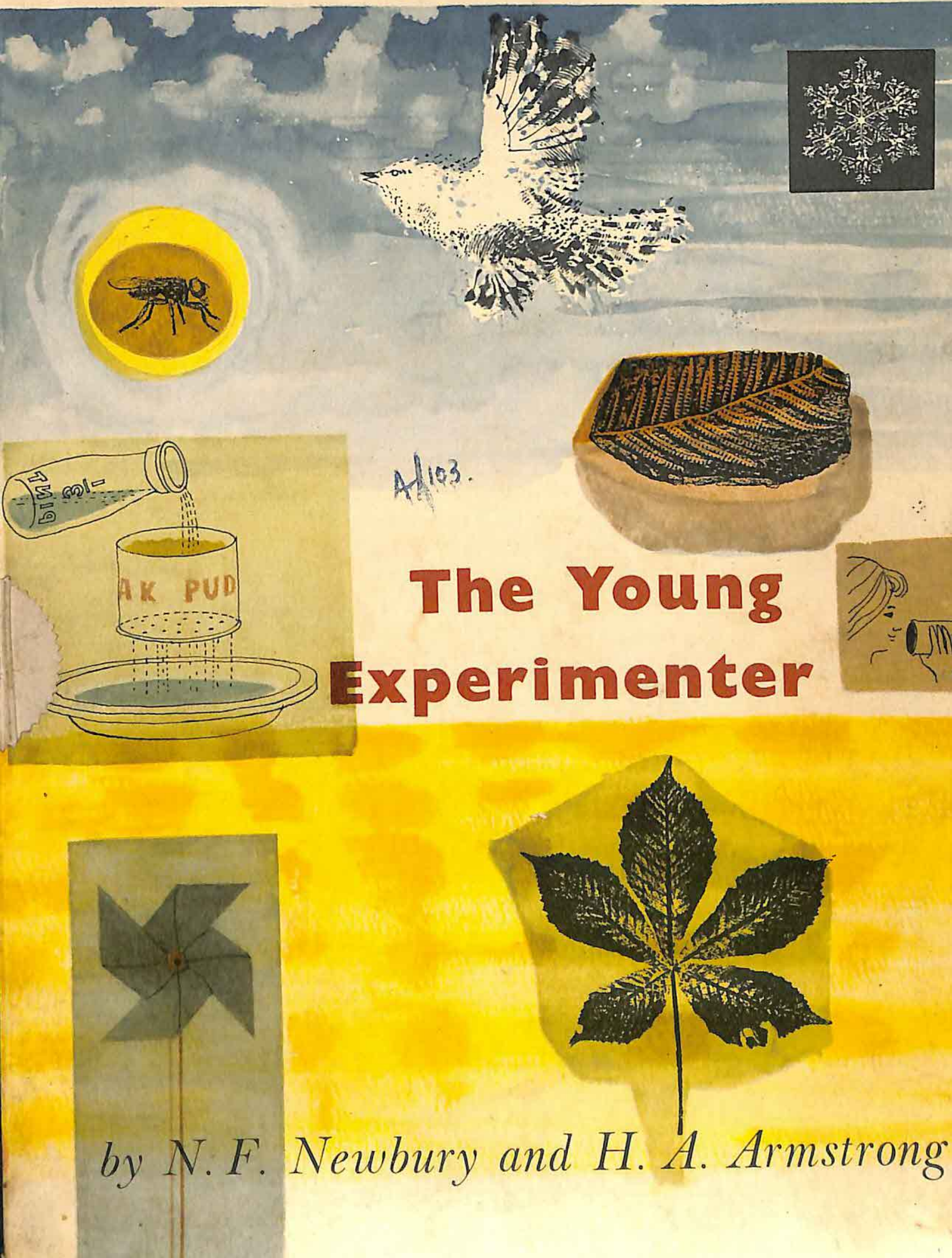
Science in Action for Boys and Girls 1

A/103.



The Young Experimenter

by N. F. Newbury and H. A. Armstrong

527/3661

4/03
STATE INSTITUTE OF EDUCATION
BANIPUR

SCIENCE IN ACTION FOR BOYS AND GIRLS

BOOK ONE *The Young Experimenter*

THE YOUNG EXPERIMENTER

N. F. Newbury and H. A. Armstrong

STATE INSTITUTE OF EDU
BANIPUR

Library

UNIVERSITY OF LONDON PRESS LTD

SCIENCE IN ACTION FOR BOYS AND GIRLS

BOOK ONE *The Young Experimenter*

BOOK TWO *The Junior Scientist*

TEACHER'S BOOK

N. F. Newbury, M.A., M.Sc., Director of Education, St Helens
H. A. Armstrong, Headmaster, Carr Mill County Primary School, St Helens

Layout and diagrams by Gerald Wilkinson
Head- and tailpieces by Margaret Ingram

[illegible]
[illegible] 13.9.05
[illegible] 11928

Copyright © 1960 by N. F. Newbury and H. A. Armstrong
Printed in England for the University of London Press Ltd,
Warwick Square, London, E.C.4,
by Hazell Watson & Viney Limited Aylesbury and Slough

Contents

To boys and girls 7

Topic 1 – *The air round about us* 11

How to begin your Science Notebook 13

2 – *More about air* 14

How to continue your Science Notebook 17

3 – *The scientist looks at life: Trees through the year* 18

4 – *How air presses on things* 23

How to become a scientist 28

How to find out if you are good at noticing things 28

5 – *How things burn* 30

6 – *A snowy day* 33

Test one: How much do you know? 37

7 – *How soil is made* 38

8 – *How the air moves* 41

Kinds of winds 45

How to find out if you are good at measuring 46

9 – *Air and breathing* 47

10 – *Heat and cold* 52

11 – *Water and plant life* 55

12 – *How sounds are made* 59

How to find out if you are good at experiments 64

Test two: How much more do you know? 65

13 – *How to make your own compass* 67

14 – *The scientist looks at life: Birds* 72

15 – *The scientist looks at life: The silk moth* 77

16–*How seeds grow* 82
17–*The scientist looks at life: Flowers* 85
18–*How the sun gives life* 90
How to find out if you are good at thinking out problems 93
Test three: How much have you learned this year? 94

To boys and girls

This book has been written to help you to become a young scientist. You will be doing many experiments yourself, either at home or at school. Like the grown-up scientist, you will need equipment, but in our experiments you will be able to use things you can easily obtain, such as wooden and cardboard boxes, tin cans and lids, strips of glass, medicine bottles, jam jars, pie dishes, pins, milk straws, Plasticine, cardboard, table-tennis balls, wood, bricks, buckets, old sinks, and the like. So have a look at anything your mother is about to throw away. It may be useful to you. Take what you can to make a good collection at school.

Other things, such as old magnets, metal tubes, cardboard cylinders, and simple stands, can be searched for in second-hand shops and junk yards and bought for a few pence. Rubber tubing, batteries, bulbs, cotton, lenses, and mirrors can be bought from various shops. Your teacher or your parent will be able to advise you here.

A scientist has to be careful not to do any damage. If you carry out the experiments at home, you must never use a polished table. Avoid damage to carpets or your mother's kitchen equipment. Take great care in handling hot metal things and be very careful where you put them when they are hot. Use the kitchen sink, an old enamel-topped table, or a protecting cover.

Be neat in the way you store your things. Put them away quite clean, in a wooden box with a lid. Label anything you want to keep. Make wooden or metal stands to hold things. Use *old* spoons or pans, *but remember, first of all, to ask permission.*

Use your common sense to avoid accidents. A thick glass jam jar will break if heated on a gas stove. Boiling water will usually crack your glass jars.

You may not succeed in getting a good result the first time. Try again, and learn from your mistakes. Read the instructions very carefully. Try little changes in your experiments until you succeed.

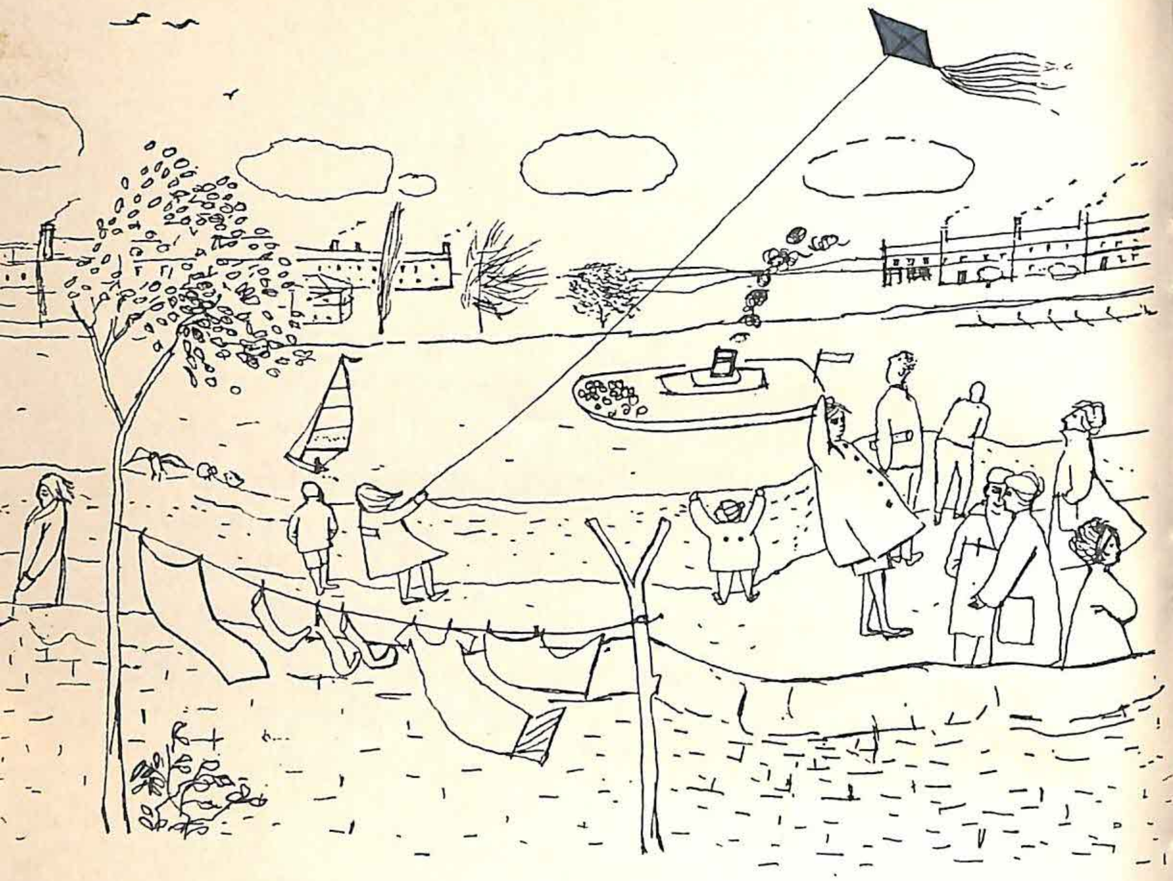
When an experiment is finished, you must keep a record of it. Draw your apparatus, and write about your experiment in your Science Notebook. Be brief and accurate in your descriptions. Often a clear, labelled drawing will be enough. Check your results with a friend. Find out from books more about the things you are investigating and make a note of them. Keep a Science Scrapbook. If you find anything interesting in newspapers and magazines, cut it out.

Most of the work you will be able to do yourself. Sometimes it will be better to work with a partner. When there is much to do, you will need a team, and the work will have to be divided among you. This is how grown-up scientists work.

Most of all, you will need an enquiring mind which is always asking questions. *Why does this happen? How can I find out for myself?*

Scientists are never satisfied. There is so much yet to be learned about our wonderful world that they must keep on experimenting and searching for new knowledge.

Perhaps when you leave school, you will be able to join them in their exciting work.



How things are affected by the wind

In how many different ways does the picture show that a wind is blowing?

Is the wind strong or not?

In how many ways is air helping to hold up things in the picture?

How can we find out from which direction a wind is blowing?

Can you think of any ways – other than those shown in the picture – in which air affects things?

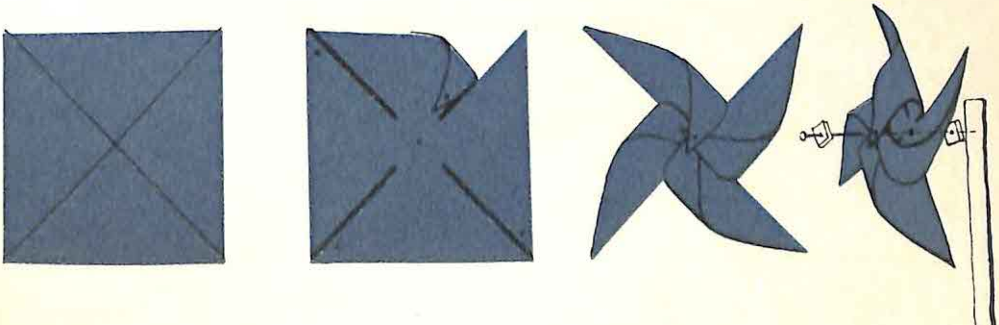
1 – The air round about us

1. How do you know that there is air in this room?
2. What shows us that there is air outside also?
3. Can we see air?
4. Is an 'empty' jam jar really empty?
5. How many names do you know for 'moving' air?

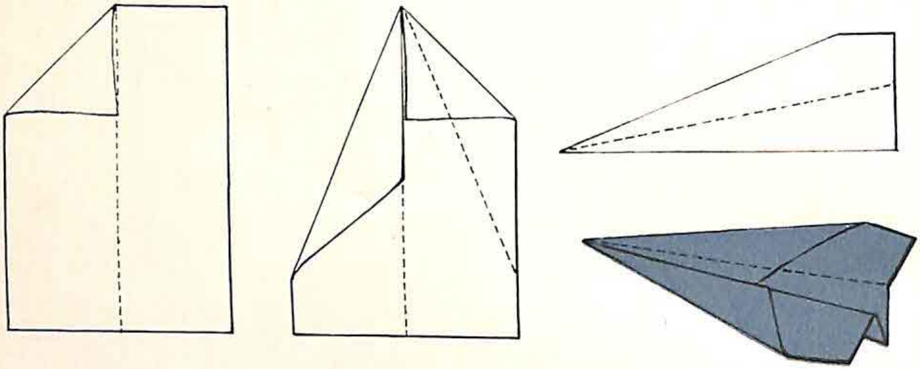
Before beginning your experiments, you will need:
sheet of note-paper, coloured paper, scissors, a pencil, stiff paper, a pin, a stick, a small piece of cardboard and a paper clip.

Things to do

1. Swing your arm about. Can you feel the air?
2. Lift a piece of paper above your head and let it drop slowly to the floor. Crumple your paper and drop it again. Is there a difference?
3. Make a paper windmill, using these drawings to help you. Cut a square of paper with 8-inch sides. Use coloured paper if you wish. Draw lines with your pencil and ruler to join opposite corners. Cut down these lines until you reach half an inch from the middle. Put pin holes in the corners and bend these over to the middle.



Fasten with a pin on a stick, with beads or little squares of cardboard as washers.
Use your windmill to prove that air can move things.



4 Here are some drawings to help you to make gliders. Have a competition with your friends to show whose glider uses the air best to travel the longest distance or to the greatest height. Glossy paper works best. Ask mother for an old shiny magazine.
Make some more gliders using different wing spans and shapes and see if there are any differences in their movements in the air. Weight the glider's nose with a paper clip. Make a note of the results of your competition in your Science Notebook. Examine the winning glider and see if you can find out why it won.

Things to remember

We cannot see air but we can feel it. We are able to see some of the things it does. It holds up large pieces of paper and gliders, as well as aeroplanes. Moving air turns the arms of windmills and blows things about.

How to begin your Science Notebook

Put the title of Topic One at the top of a page in your notebook.

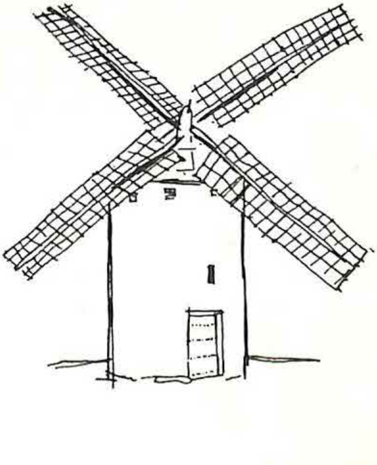
Look at the picture at the beginning of this Topic. Write one sentence each about any three of the things in the picture, using the word 'air' in each sentence.

Finish these sentences and write them in your notebook:

1. We know there is air in the room because ....
   ....
2. An 'empty' jam jar is really filled with ....
3. We know there is air outside because......................
   ....

Have you talked about all the different words we use for 'moving' air? Write down as many of them as you can.

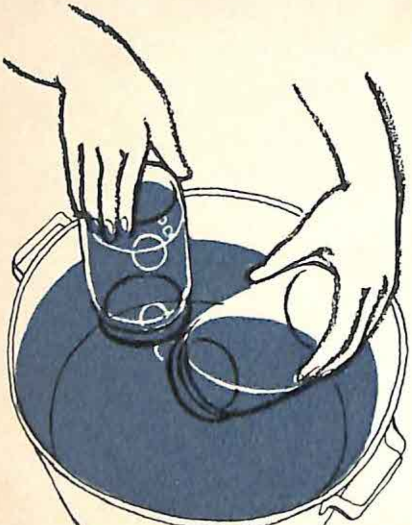
Use your coloured pencils or crayons to draw sketches in the spaces on your page to tell the story of the air round about us.



2 – *More about air*

1. How does a pilot escape from a damaged aircraft?
2. What is a windmill used for?
3. How many different ways are there of sending a boat or ship along through the water?

You will need: two jam jars, a glass tank or bucket, rubber tube, a handkerchief, a small stone, string, paper, stiff cardboard, a penny, thin paper, two footballs with their bladders, a pump, a long ruler, a balloon, Plasticine or a small bag of sand.



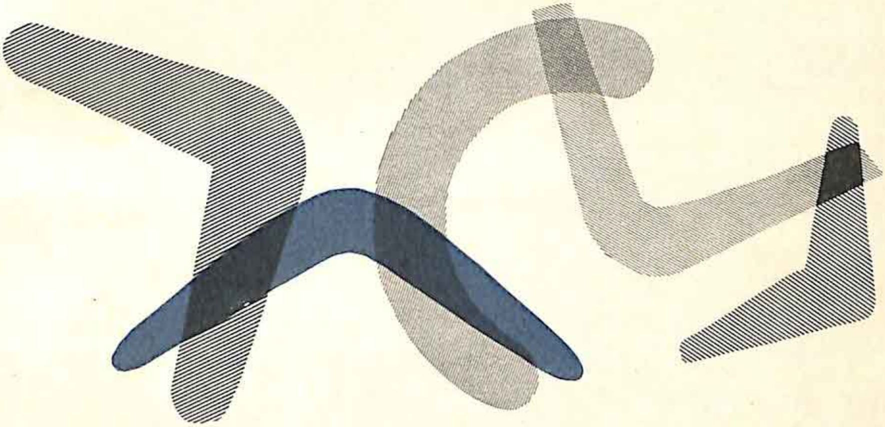
Things to do

1. Press a jam jar mouth downwards into a large glass tank or bucket nearly filled with water, until it touches the bottom. What happens to the level of the water in the tank? Why is this?
2. Put a second jam jar in the tank of water and allow it to fill with water. Show that the jam jar of air you had in the first experiment can be tilted so that the air passes into the jam jar of water.

3 Show that you can collect the air from your mouth in a large jar of water by using a rubber tube.

4 Make a parachute out of a handkerchief by tying string to its four corners and tying the loose ends of the string to a stone. Go outside and try it.

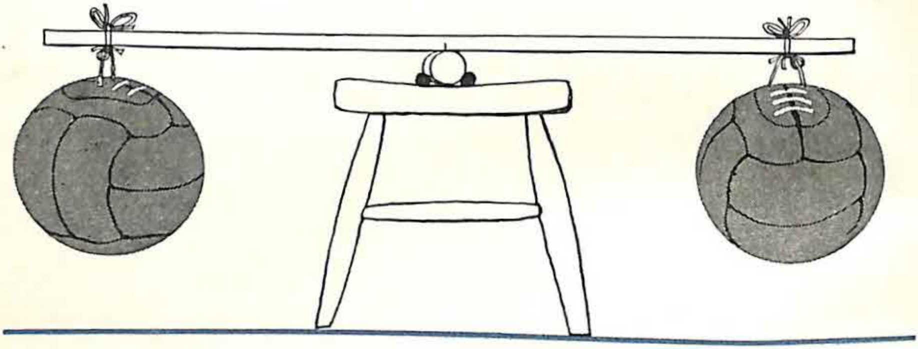
Now make a parachute out of paper and try it. Then cut a hole in the middle. Why does it now come down differently?



5 Cut boomerangs from stiff, smooth cardboard and slightly bend one of the wings of each. The best way to try them is to put them on the edge of the table and strike with a gloved hand or finger.

6 Get a penny and a piece of thin paper. Drop the penny from shoulder height from one hand, and the paper, cut to the size of a penny, from the other hand. What is the difference in the way they travel to the ground? Now put the paper on top of the penny and drop them both together. What happens?

7 Balance two similar footballs, with empty bladders inside, on the ends of a long ruler or piece of wood. Blow one up with air until it is hard and replace in exactly the same place. Do they balance now? Release the air and repeat. What happens?



You can do another experiment in the same way by balancing a blown-up balloon with a bag of sand or a piece of Plasticine. Let the air out of the balloon. Is it true that air has weight?

Things to remember

The earth is surrounded by a blanket of air. Air is everywhere and takes up space. Although air is very light, it has weight.

Air is a GAS.

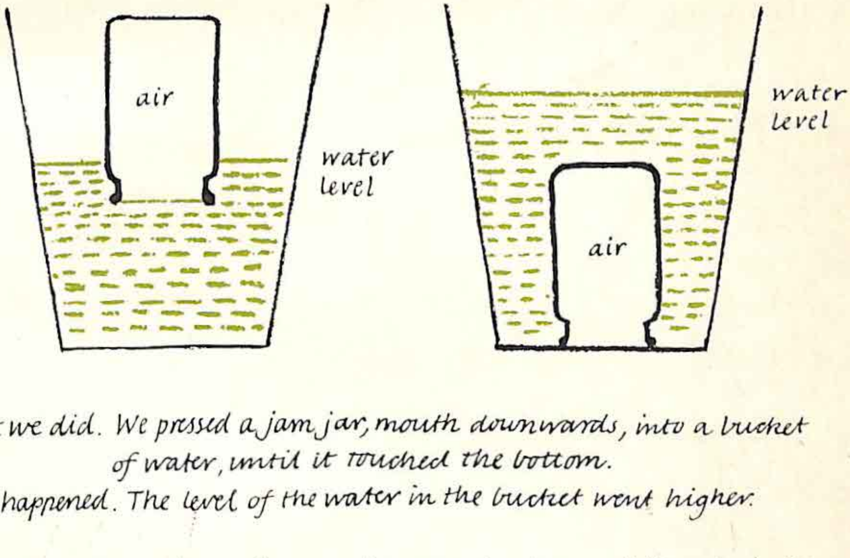
Water is a LIQUID.

The earth is a SOLID.

How to continue your Science Notebook

You must keep a record of as many experiments as you can. Draw the things you use and say what happens and why. Do not try to draw sketches like those in the book. It will be quicker to make simple ones like the one below. Coloured pencils will help to make your drawings clearer.

Experiment 1. AIR



What we did. We pressed a jam jar, mouth downwards, into a bucket of water, until it touched the bottom.

What happened. The level of the water in the bucket went higher.

Why it happened. The water rose because the jar and the air inside it took up space and pushed up the water

We know that: 1. Air takes up space
2. The air in the jar keeps the water out

Copy this sketch and the description of the experiment into your Science Notebook and then make up your own notes for the other experiments.

3 – The scientist looks at life: Trees through the year

1 What are the differences between a daisy, an oak tree, and a privet?

2 How many ways do you know in which trees are useful?

3 How are Christmas trees (firs) different from most trees?

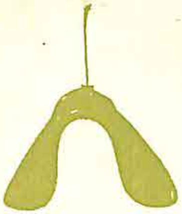
4 Strong winds are enemies of trees. Do you know any other enemies of trees?

Things to do

1 Get each of your team to choose one convenient tree to study. Compare all your notes and sketches with those your friends make of their trees.

Look carefully at your tree throughout the year and make a Tree Book for your discoveries. Leave spaces for monthly notes. Here are some of the things to look for.

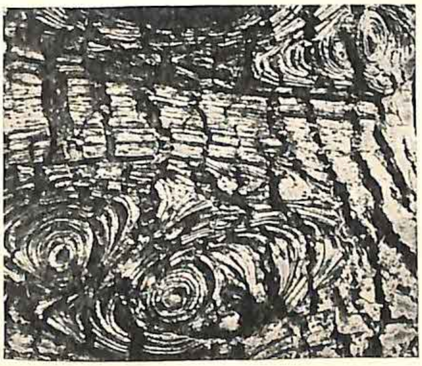
The shape of the leaves. Are the edges like teeth or plain? What is the colour? Have they long or short stalks? Are the leaves smooth or rough? Make drawings or take photographs of your tree in summer and winter.

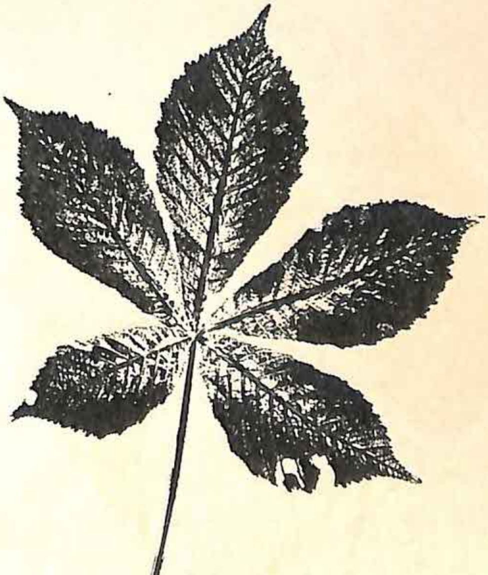


What is the colour and shape of the flower and fruit of your tree? Has the fruit prickles on it? Are they in a cup? Have they wings? Are they single or in clusters?

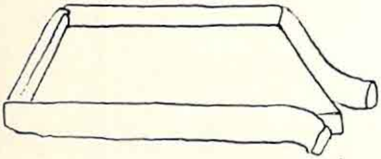
2 Make a bark rubbing of your tree. To do this, press a piece of tough greaseproof paper hard against the bark and rub with cobbler's wax. Compare your rubbing with those of your team. Arrange a display of your team's rubbings.

3 Make leaf prints of your single or compound leaves. To do this, put your leaf beneath greaseproof paper and scribble on it with cobbler's wax or crayon.
Another way is to use a rubber roller and printing ink. Rub an inked roller carefully over your leaf. Put it on some clean paper and cover it with another piece of paper. Now roll carefully on the top paper with a clean roller. Cut your printed leaf out when it dries and mount it in your Tree Book.

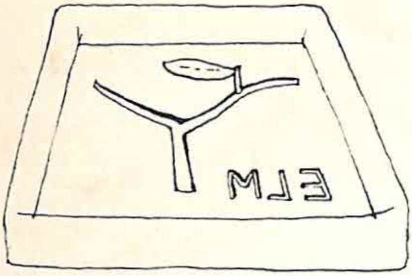




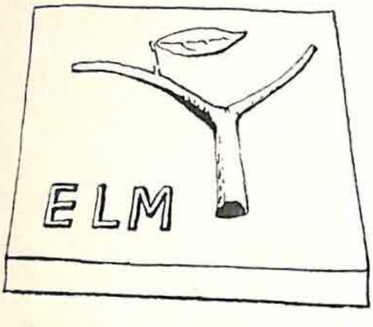
4 Make a plaster cast of a leaf or leaves. Twigs come out very well in plaster, too.



Make a Plasticine base and build walls around it about one inch high. Smear the twigs thinly with Vaseline.

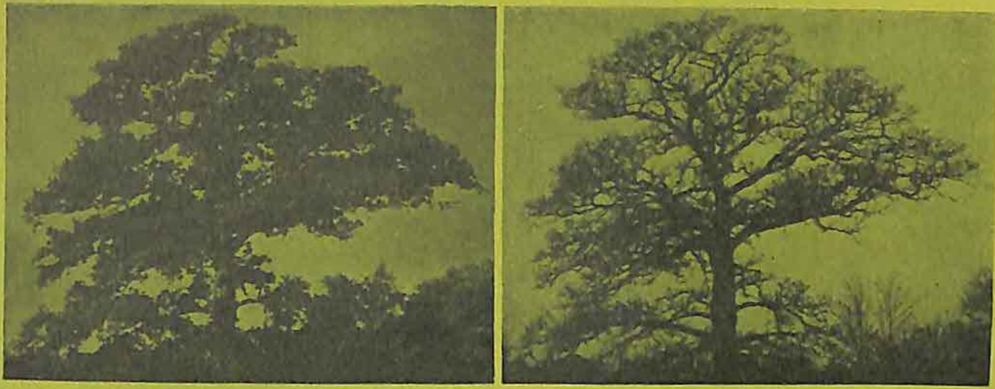


Press your twigs firmly but carefully into the Plasticine so that they make a deep imprint. Write your tree's name in mirror writing at the bottom so that it will come out in your cast.



Take out the twigs and pour in plaster of Paris and allow to set. Then take off all the Plasticine. Colour the casts of your leaves and twigs with water-colour paints. Arrange a display of your team's casts.

5 Try to grow trees from seed, for example, sycamore, oak, horse chestnut, or beech. Put a mixture of sand and finely sieved leaf mould in a jam jar and set your seed. Cover with moss and keep damp and warm. When your little trees are about an inch high in spring, move them to the garden to grow and carefully plant them with a label near them, giving the date and your name.



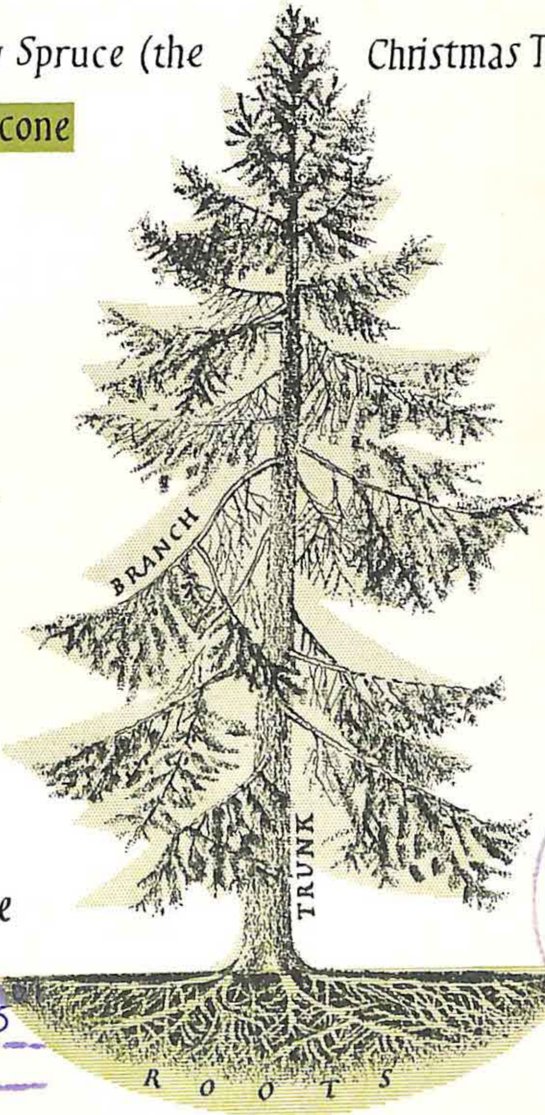
The oak tree is deciduous – it loses its leaves in winter

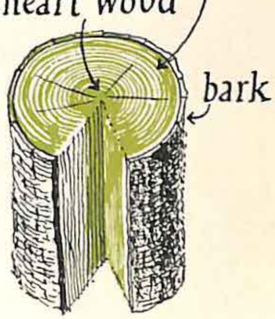
The Norway Spruce (the Christmas Tree) is evergreen

Its fruit is a cone

The tree is a conifer

Its leaves are needles





The trunk shows its age by annual rings of growth

The wood from this tree is called White Deal

Date 13.9.05
Acc. No. 11928

Things to remember

Trees breathe and feed like other plants. A tree is different from small plants because it has a thick trunk and can grow larger for many years. If you look at a stump of a tree that has been cut down you can tell its age by the number of annual rings. These mark the new growth of the tree every year. In the autumn the tree grows new buds and protects them with a covering during the winter. In spring, the buds open and new leaves and flowers grow. Later, the fruit of the tree grows to hold the seeds from which young new trees can be born.

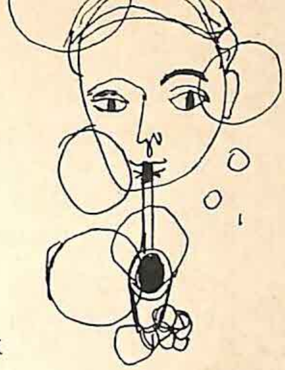
In your Tree Book

Make a list of the trees which grow in your district and find out all you can about them.

Make a list in your book of things which are made from wood.

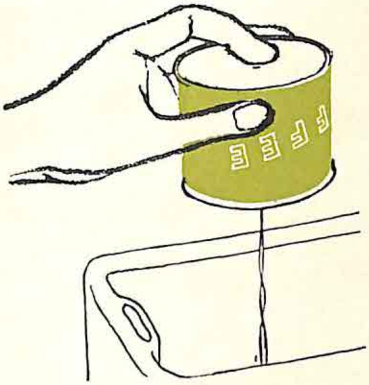
Find out what you can about lumbering, paper making, and the manufacture of pencils and plywood.

4 – How air presses on things



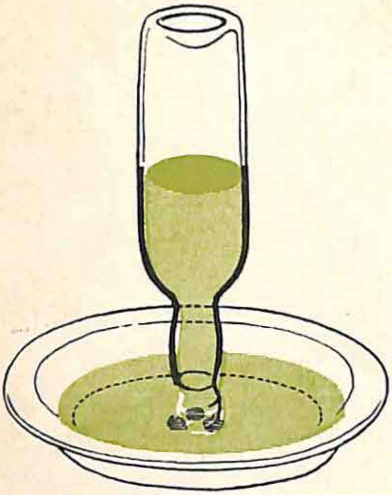
1. Why do you need two holes in a tin of milk before the milk will pour out?
2. Why are aircraft cabins sealed for very high flights?
3. How is a soap bubble formed when it is blown from the bowl of a pipe?

You will need: a penny, rubber sucker, thin soft piece of leather, string, a large stone, a tall bottle, a pie dish, a small tin, a jam jar, cardboard, bits of Plasticine, an egg, a potato, a small sheet of metal or glass.



Things to do

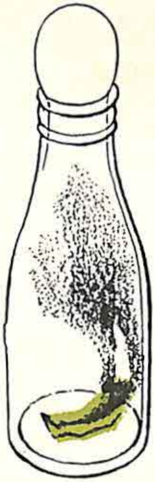
1. Get a tin and make a small hole in the lid and one in the bottom. After you have filled the tin with water, put the lid on firmly and keep your finger on the hole at the top. Now show your magic tin to your friends, saying, 'Water, run! Water, stop!' over the sink. You can control the flow of water by removing and replacing your finger. Why is this so? Repeat the experiment with the tin upside down. Does it work better?



2 Fill a tall bottle with water and, putting your finger over the open end, invert it in a dish which has half an inch depth of water in it. Use bits of Plasticine to keep the bottle off the bottom of the dish. If you take out water from the dish with a spoon, you will see the water level in the bottle fall. What keeps the water in the bottle?

3 Press a damp new penny on your forehead. You may walk about a long time before it will fall off. How much air is there between the penny and your skin? What is the air doing on the outside of the penny?

4 You have seen a rubber sucker work. What has this to do with air? You can make a much larger sucker with a piece of thin, soft leather. Soak the leather in water, then cut it into as large a circle as it will make. Make a small hole in the middle so that a string knotted at one end can be put through. Now press it firmly on a stone. You will be surprised how large a stone may be lifted in this way. Press it on a door. Try it on a number of flat surfaces. Does the air press equally in all directions?



5 Choose a bottle with a neck which will just hold an egg. Boil the egg hard and remove the shell. Put a piece of burning paper into the bottle. Now put the egg on the top of the bottle and watch. As the air in the bottle cools, the air outside presses more heavily than that inside, and the egg will be pushed into the bottle. Can you think of any way of getting the egg to come out of the bottle again?

6 Fill a jam jar to the brim with water. Slide a piece of smooth cardboard across the top. Put your hand on the cardboard and invert over the sink. If you have put the card on properly, the water will remain in the jar even when upside down and your hand removed.

7 Cut a potato across with a sharp knife. Press the half potato hard on a metal plate. Lift up the plate with the potato. What is supporting the plate? (A tin lid may be used instead of a plate.)

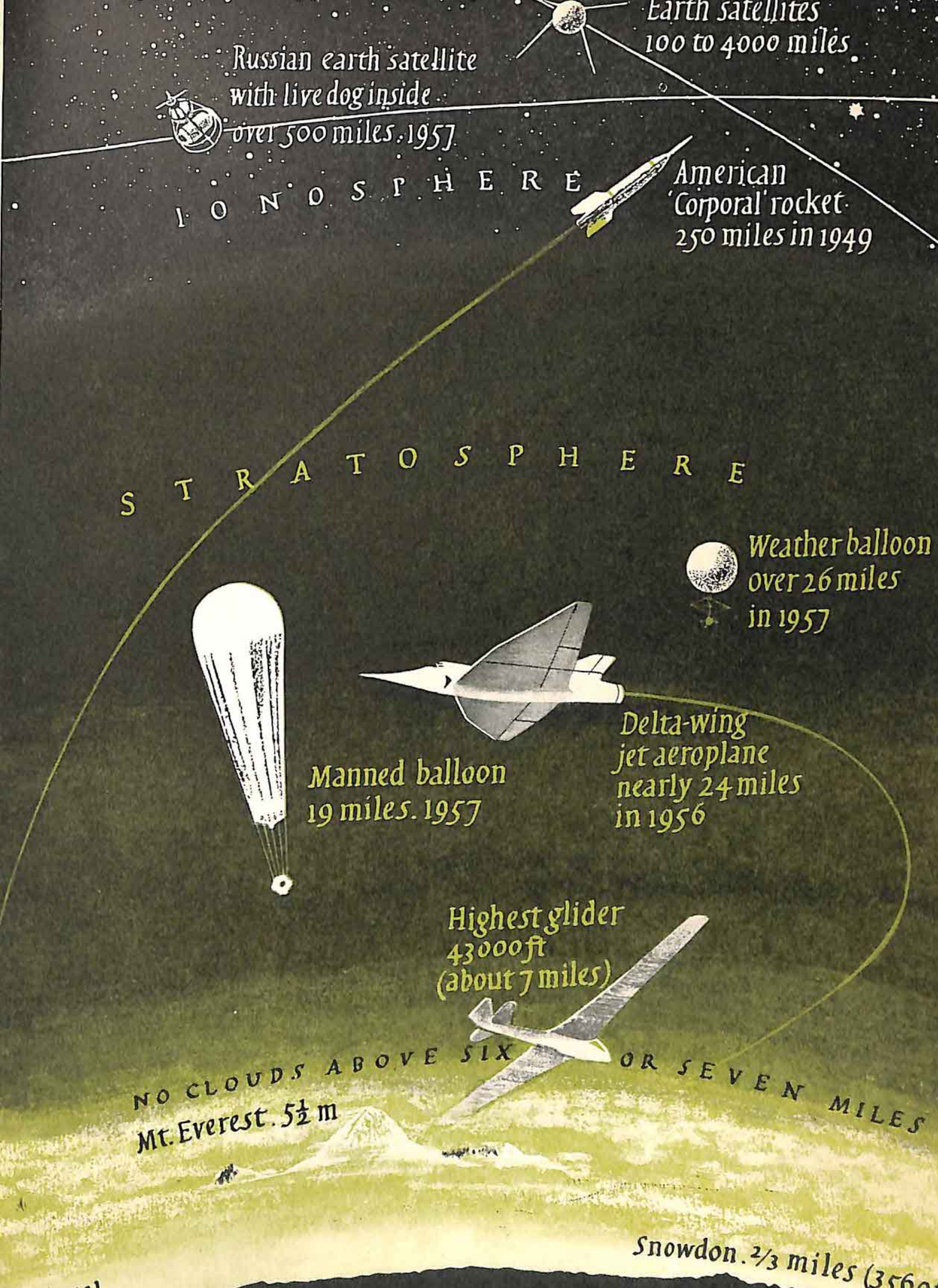
Things to remember

Air presses on things. It presses equally in all directions. Scientists know that air extends for many miles around the earth but it gets rarer as we go higher. You can feel the difference in pressure in your ears if you quickly climb a hill in a car or go down a deep mine in a lift. Look at the picture opposite to see how high man has travelled.
Birds have a special shape to fly through the air and man has copied this shape for his aeroplanes.

In your Science Notebook

Make a record of all your experiments in the way you have been shown.
Do you know what 'streamlined' means?
Do you know in which sort of book to look it up?
Which sort of book would you need to look in if you wished to learn more about streamlining?
Find out the answers to these questions:

1. What moving things are streamlined?
2. What does a bird do just before it lands?
3. How do scientists find out the best streamlined shapes for things?


Earth satellites
100 to 4000 miles
Russian earth satellite
with live dog inside
over 500 miles. 1957
IONOSPHERE
American
'Corporal' rocket
250 miles in 1949
STRATOSPHERE
Weather balloon
over 26 miles
in 1957
Delta-wing
jet aeroplane
nearly 24 miles
in 1956
Manned balloon
19 miles. 1957
Highest glider
43000 ft
(about 7 miles)
NO CLOUDS ABOVE SIX OR SEVEN MILES
Mt. Everest. 5½ m
Snowdon. 2/3 miles (3560

How to become a scientist

1. You must practise looking very carefully, so that you can remember afterwards what has happened.
2. You must be able to write down what happened or tell someone else about it.
3. You must be curious to find out things and ask questions.
4. You must know where to find the answers to your questions.
5. You must be able to experiment yourself to test whether you know the right answer.
6. You must learn to argue from what you have proved and not to make wild guesses or say silly things.

At the bottom of this page, you will find a test to help you to find out if you are good at noticing things.

Try the first test and see how many marks you can score.

Other tests later on will help you to find out:

if you can measure,
if you can do experiments,
if you can find out answers to problems.

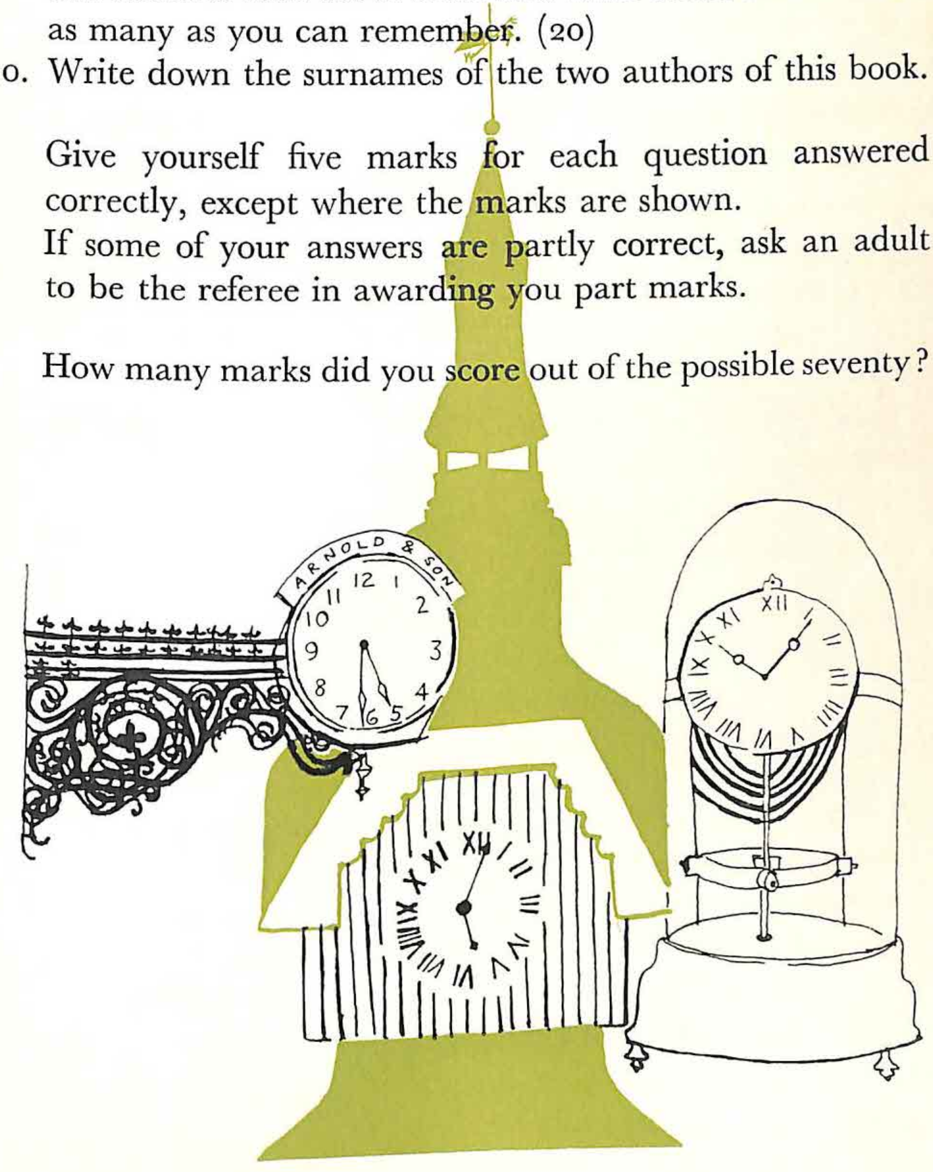
How to find out if you are good at noticing things

1. Without looking, write down how many windows there are in your classroom.
2. What colour is the front door of your school painted?
3. How many classrooms are there in your school?
4. How many legs has a donkey, a fly, and a spider? (6)
5. How is the figure five shown on
   (i) your clock at home? (ii) your school clock? (iii) the nearest public clock to your school? (9)

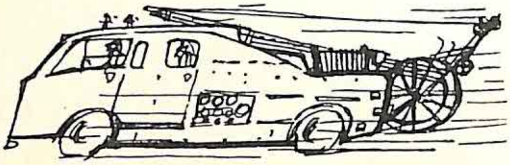
6. What are the car registration letters for your district?
7. Where is the nearest pillar box to your school?
8. Where is the nearest telephone box to your school?
9. Put twenty different objects on a table. Look at them for two minutes then cover them and write down the names of as many as you can remember. (20)
10. Write down the surnames of the two authors of this book.

Give yourself five marks for each question answered correctly, except where the marks are shown.
If some of your answers are partly correct, ask an adult to be the referee in awarding you part marks.

How many marks did you score out of the possible seventy?



5 – *How things burn*



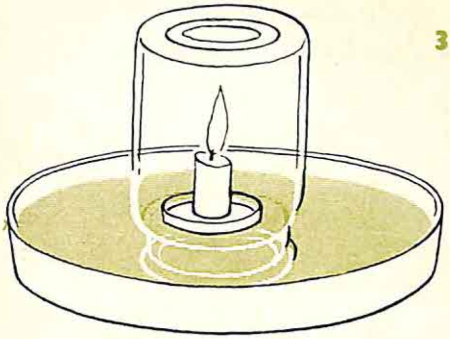
1. Can a fire burn without air?
2. What are the chief causes of things setting on fire?
3. Where are the fire extinguishers in your school? How many are there altogether? How is the alarm sounded?
4. If your school set on fire, where would the fire engine come from?

Things to do

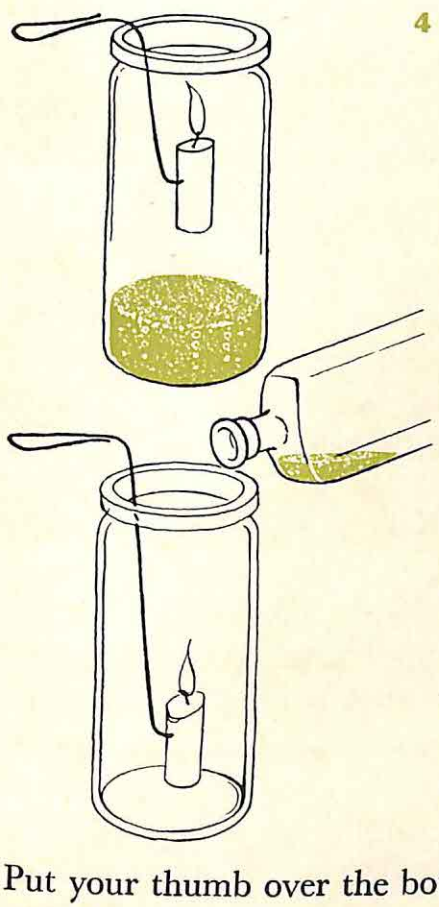
You will need a candle, a piece of wire, two tin lids, two jam jars of different sizes, a flat cork, some washing soda, some vinegar, a small amount (a tablespoonful) of paraffin oil, a piece of metal, some sand.

1. Put a lighted candle on a tin lid. Place a one-pound jam jar over it. Notice what happens. Relight the candle and quickly put the jar back. The candle will not burn. Why?

2. Light your candle and put a two-pound jam jar over it. Does it take longer for the candle to go out? Use smaller and larger jars, and time the experiment with a watch. Record your results in a table.



3 Stick a small candle on a flat cork with molten wax and light it. Float it on water and put a jam jar over it. Allow to cool. Watch carefully and see if the burning candle uses any of the air.



4 (*a*) Put two or three teaspoonfuls of washing soda in a tall narrow jar. Pour vinegar on it. There will be much bubbling and you will have made a heavy gas called carbon dioxide. Lower a candle on a piece of wire into the jar. What happens?

(*b*) Put a lighted candle at the bottom of another narrow jar. Pour out carbon dioxide from a medicine bottle, into this jar, without spilling the soda and vinegar. The gas will fall into the jar because it is heavier than air. What happens to the candle flame?

Put your thumb over the bottle top and shake. Now squirt out the soda and vinegar on to a candle flame. You have made a soda-acid extinguisher.

5 In the presence of an adult put a little paraffin oil on a small piece of rag on a tin lid placed in a bucket. Light it. Cover it up with a larger tin lid. Air cannot get to the fire. What happens? If you throw a handful of sand on the flame, does it go out?

Things to remember

About one-fifth of the air is oxygen. Air is needed for burning because fire uses oxygen. If you prevent air getting to fire, it will go out. You can stamp a small fire out. A big fire needs the fire engine and powerful jets of water. Sometimes a blanket of sand or carbon dioxide is used. A person on fire is usually rolled in a blanket or some such material to prevent the air helping the flames.

Fire extinguishers, like those in your school, will probably make carbon dioxide when being used on a fire. Fire is ALWAYS dangerous. Remember to use it carefully because it is a useful friend but a deadly enemy.

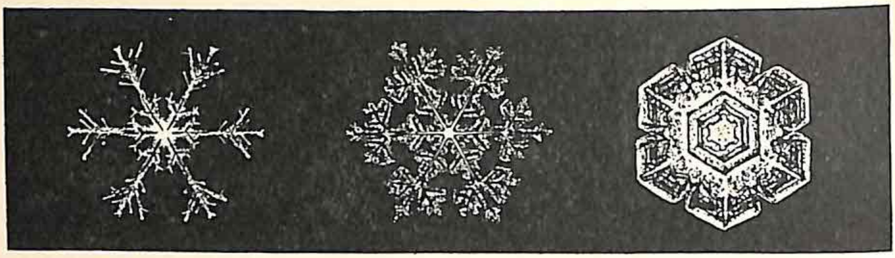
In your Science Notebook

Draw neat sketches of Experiments 1, 2, 3, 4, and 5.
Label all the different things neatly.
Write one sentence to tell what the experiment proved.

The next topic will need to be studied in snowy weather. To help you, the things required have been printed in *italic* type. In later topics, you must read carefully through the experiments and write out a list of the things you will require.

6 – *A snowy day*

1. What is it like outside in frosty weather?
2. Have you noticed the inside of your window panes in very cold weather? Can you find any ice crystals on the glass?
3. Do you know how deep the ice is on a frozen pond or lake?
4. Does the water start to freeze at the top or the bottom of a pond?
5. What harm does ice cause?
6. Why must the ice be kept broken on a pond on which ducks live? What ought you to do to supply birds with a drink in frosty weather?



Things to do

1 Collect a few flakes of snow on a piece of *black paper*. Immediately look closely at each flake under your *magnifying glass*. Copy the different shapes shown above in your Science Notebook. Try to catch a single crystal. How many sides has it?

2 Take a handful of snow and press it firmly together. Notice that as you press, the snowball becomes much harder and smaller and a little of it is melted by your pressure. What is there between the snow crystals which makes it so loosely packed?

3 Pack a *tin can* loosely with fresh snow. It is best to push the can open end downwards into the snow to fill it. Put the can filled with snow into a *saucepan* of warm water or on a hot radiator. What happens to the snow? How much water forms in the can? Is it more or less than the amount of snow?

4 Put some pieces of ice in a *large jam jar* of water. Do they float or sink? Try to push them to the bottom. How much of the ice is below the surface of the water when you let it float freely? Cubes of ice from a refrigerator or natural ice may be used.

5 Fill *three medicine bottles* with water. Put the cork firmly in the first one. In the second one, tie the *cork* with *string* so that it cannot come out. Do not cork the third one.
On a very cold night, put the bottles outside. Next morning find out what has happened to the three bottles.
If you want to make your own cold conditions, put a mixture of ice and salt in a container such as a saucepan and pack it round your bottle. Try the experiment with a *metal polish tin* with a *screw top*.

6 Put a *dish* of water outdoors and watch it freeze. Where does the water begin to freeze?

Things to remember

Snow and ice are made from water. It must be very cold for this to happen. Warmth will change snow and ice back into water. Pressure, too, will make them melt. The weight of your body pressing on ice skates makes water form underneath the skates and you can move along the ice more easily.

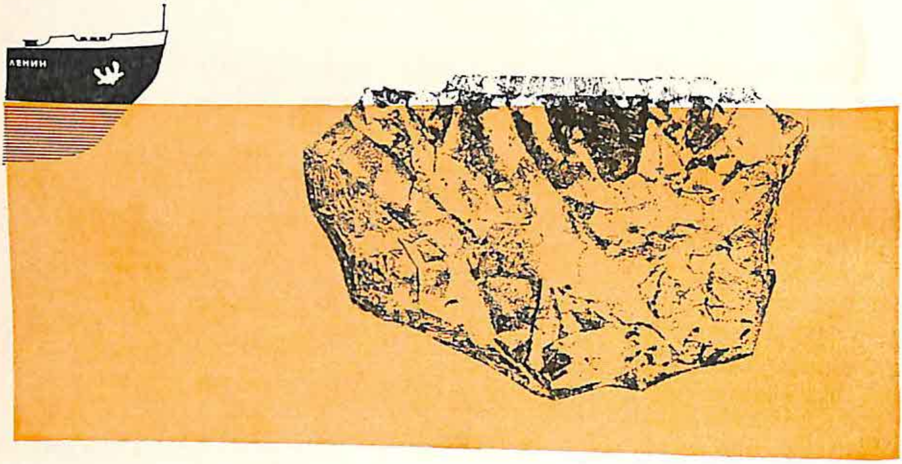
About twelve inches depth of fresh snow when melted forms only one inch of water. On a pond, the top freezes first but even in very cold weather a pond rarely freezes completely.

An iceberg is solid ice. The part seen floating above the surface of the sea is only a small part of the berg. Why is this dangerous?

Water turning to ice expands. When water freezes in a pipe, the expansion of the ice sometimes bursts the pipe. The pipe is burst by the ice but it is only when the ice thaws that we find out that the pipe has been damaged.

Water can be either a SOLID — Ice
or a LIQUID — Water
or a GAS — Steam

according to the temperature.



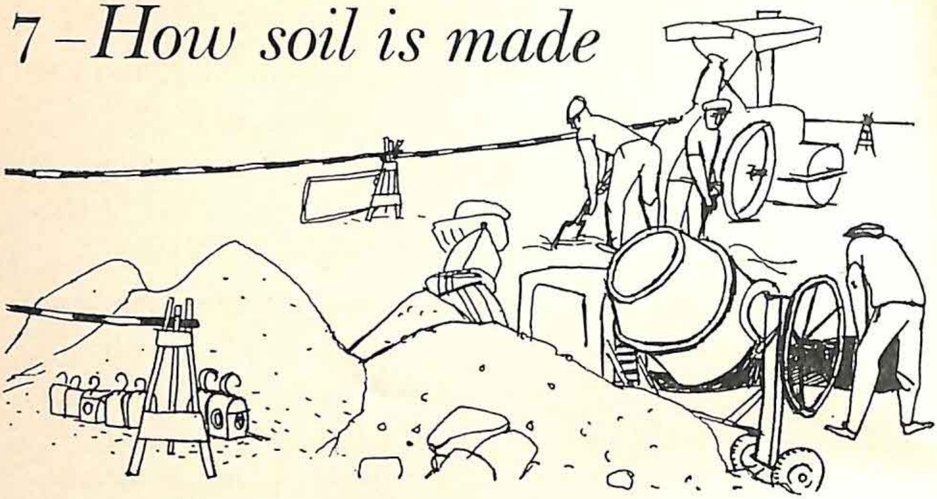
In your Science Notebook

1. Make a record of Experiments 3, 4, and 5.
2. Look up in a reference book the different shapes of snow crystals. How many did you see under your lens? Add those you did not see to your record.
3. Look up the meaning of the following words in your dictionary or an encyclopædia and write a few lines on each: refrigerator; snow blindness; frostbite; Arctic Circle; thaw.

REMEMBER that for your next Science Topic you will need a list of the materials required. Read through the next topic and see what this list will be.

1. Write a complete sentence by filling in the blanks below. Put in as many words as you need.
   (*a*) Air is needed for ——— by human beings.
   (*b*) Snowflakes are made from ———.
   (*c*) Ice forms on the ——— of water because it is ——— than water.
   (*d*) Wind is ———.
   (*e*) ——— in the air is needed for breathing.
2. What is the best kind of day for drying clothes outside? In which way does a housewife arrange the clothes so that they dry more quickly?
3. Write down everything you would do if you saw a house on fire.
4. Write on your paper *a*, *b*, *c*, *d*, and *e*. Put T if the sentences below are true and F if they are false.
   a. A fire must have air to burn.
   b. When water freezes it expands.
   c. Air does not weigh anything.
   d. An iceberg is hollow ice.
   e. A plant grows into a shrub and a shrub into a tree.

7 – *How soil is made*



1 Have you ever seen layers of earth in a trench dug by workmen? Try to find a place where you can see them.

2 How do you think weather, water, wind, and animals help to make soil?

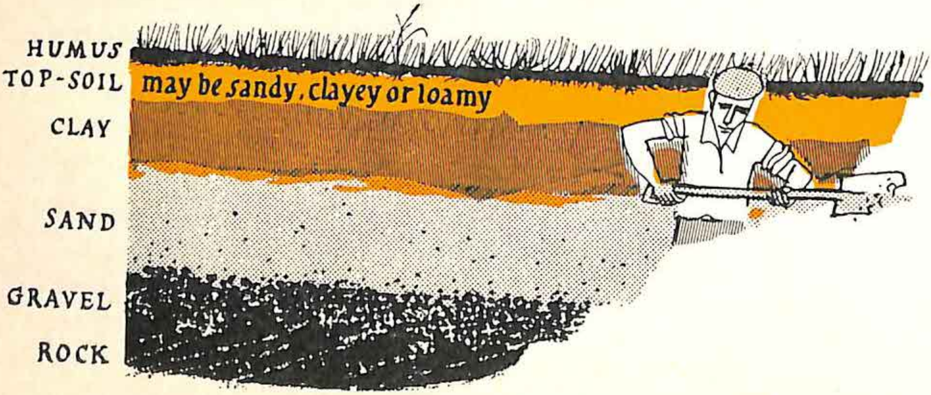
3 Why does the farmer add manure to soil? What makes soil 'good' or 'bad'? Give a more exact word for 'good'.

4 What different kinds of soil are found near your home?

5 How many different kinds of rock or stone do you know?

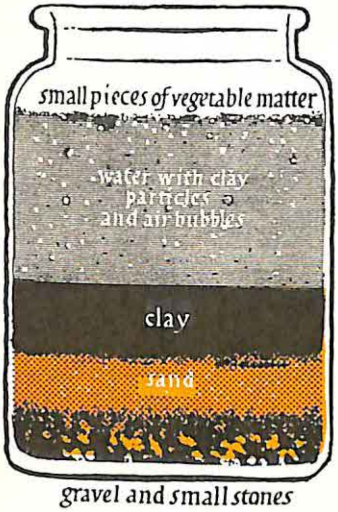
6 What is a fossil?

7 What industries use (*a*) clay? (*b*) sand?



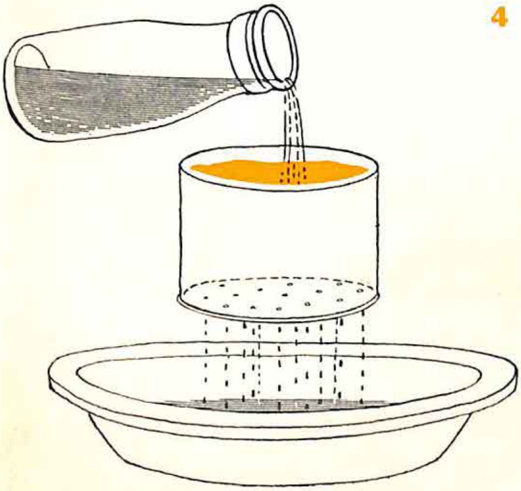
Things to do

1 Collect samples of the earth including sand, clay, and hard rocks. Arrange them on a table in groups. Look at them with your magnifying glass. Feel them, note their colour and their hardness or softness. Which rocks are found on the seashore? On mountains?


small pieces of vegetable matter
water with clay particles and air bubbles
clay
sand
gravel and small stones

2 Put a handful of garden soil in a large jar filled with water. Stir it up with a stick and then allow it to settle. Try different samples of soil from other places in more jars. When the soil has settled down, run off the water and examine the different layers. Is your result different from the drawing?

3 Put some garden soil in a jar of water. Look carefully to see what happens. What are the bubbles?



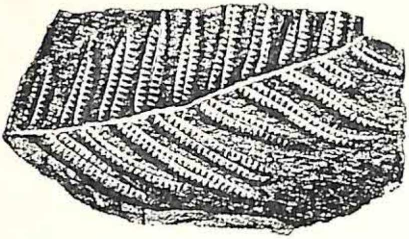
4 Knock small holes in the bottom of a tin. Fill the tin with sand and hold it over a pie dish. Pour water in at the top and see how long it takes for the water to pass through. Repeat the experiment using clay, gravel, and ordinary soil in the same size of tin, with the same number of holes.

5 Rub two rocks together to see if you can make soil.

6 Use a hammer to find out how different rocks can be broken down into soil. Ask a grown-up to show you that rocks are affected by heat. Ask to be shown a piece of hot rock dropped into a bucket of cold water.

7 Mix some soil and water together to make mud. Put the mud on some paper and rest heavy weights on another piece of paper on top. Leave it for a few days then examine it. Can you see how pressure makes rocks? Do the experiment again and this time put a leaf on the mud first. Do you know how coal was formed in the earth?

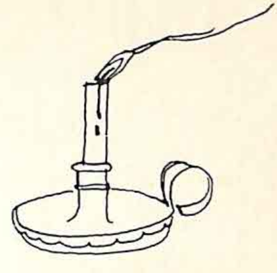
8 Fossils serve as records. Examine a fossil and try to read the story behind it.



Things to remember

The surface of the earth we use for farming and gardening is soil. It is usually a mixture of sand, clay, gravel, limestone and humus. Humus is made up of plant life which has died and fallen to the ground. Water runs easily through sand but not through clay. Soil contains many useful and harmful creatures which we will be studying in Book Two. Hard rocks are broken down by the sun's heat, by rain, frost, and by rivers.

8 – *How the air moves*

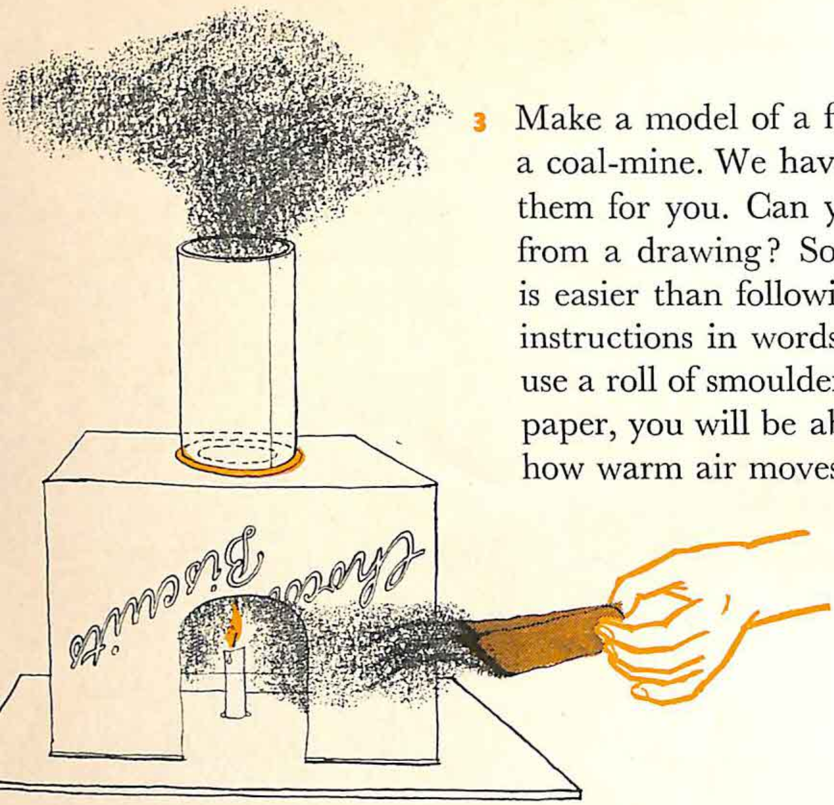


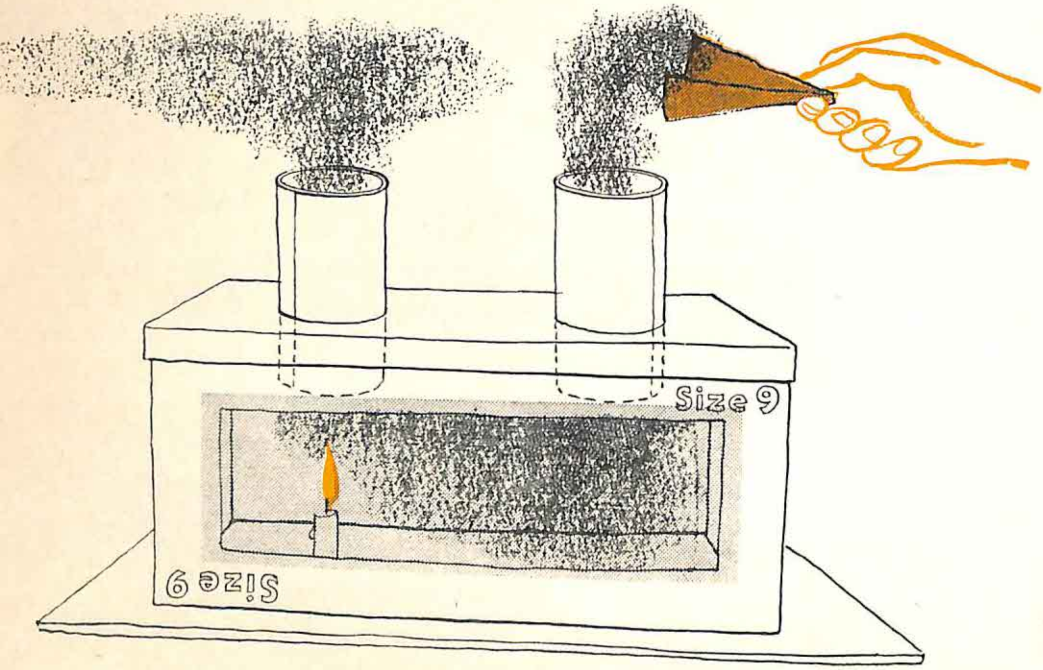
1. Have you heard that bicycle and motor car tyres get bigger on a hot day? Why is this?
2. Is there a draught in any of the rooms in your home or school? Where does it come from? Where does it go to?
3. Why does a room become 'stuffy'?
4. How is air kept fresh in a coal-mine? in a cinema?

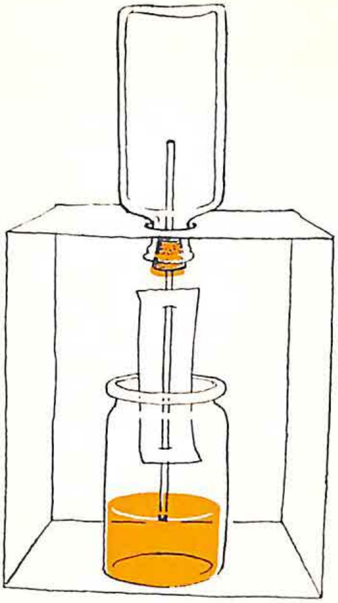
Things to do

1. Hold an empty medicine bottle mouth downwards in the water in a tank. Put your warm hands around the bottle. Watch the bubbles of air which pass through the water. Is it true that air expands when heated?
2. Put a balloon over the neck of your bottle. Put your hands round the bottle. What happens as the air warms up? What happens as it cools? Warm and cool your bottle by using warm, then cold water in a bucket.

3 Make a model of a fireplace or a coal-mine. We have drawn them for you. Can you work from a drawing? Sometimes it is easier than following instructions in words. If you use a roll of smouldering brown paper, you will be able to show how warm air moves.







4 Put a thin piece of glass tubing through a cork in a medicine bottle. Colour some water in your jam jar with ink. Now fix a piece of cardboard on your tube in the way shown in the drawing. Put your hand round the bottle. What do you see? Mark the card. Do you know the name of the instrument that scientists have made using experiments like yours?

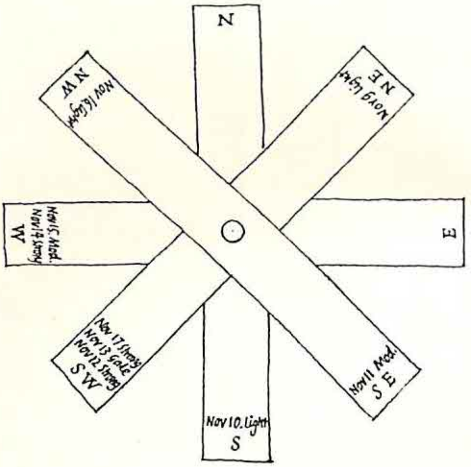
5 There are many other ways of showing that air moves: a lighted cigarette held over a hot radiator; a lighted candle near an open door; a smouldering piece of string held near the top then the bottom of an open window. Can you think of any more?

Things to remember

A volume of air expands on heating.
Hot air is lighter than cold air. Hot air rises.
Air moves round a room and ventilates it. The used air goes out at the top of the window and fresh air takes its place.

In your Science Notebook

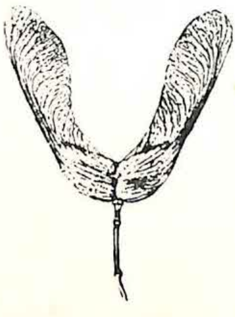
Make a record of your experiments showing how air moves. Here is a simple way of keeping a record of how the wind blows each day. You should enter on the wind-rose the speed and direction of the wind each day. The way to find the speed is shown opposite. Find out how to mark North and South on the playground, or on a board in the garden, for the direction. Remember that it is the direction the wind comes *from* that you want, e.g. a West wind comes *from* the West.



In late summer or autumn, remember to collect different kinds of seeds which are blown by the wind. Make a display of them on your Science Table. Some have little propellers. Why is this? Keep the seeds for springtime.

Match these names to the seeds below and draw them in your book: dandelion; sycamore; ash; Scots pine.

How would you find out the direction of the wind if you were the captain of a football or a netball team and you had won the toss?

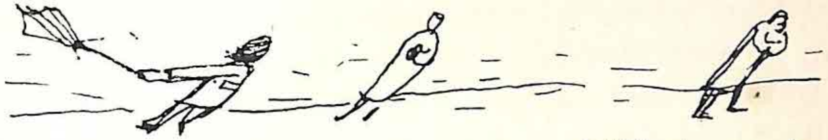


Kinds of winds You can tell the kind of wind that is blowing by using your eyes. What kind of wind is blowing outside now?

CALM. Sea smooth. Chimney smoke goes straight up.

LIGHT. Moves smoke but not wind vane.

MODERATE. Raises dust and just moves twigs.



STRONG. Moves large branches. Difficult to keep umbrella up.

HIGH. Whole trees in motion.

GALE. Trees uprooted. Damage done.

How to find out if you are good at measuring

Ask a grown-up to help you with the marking.

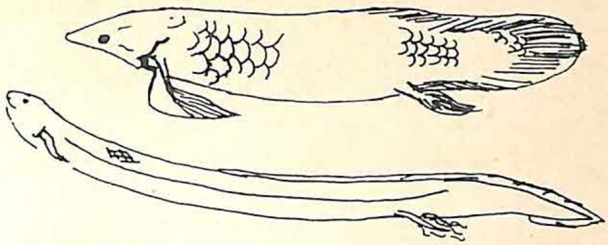
marks

1. Make a guess as to how many threepenny bits and how many halfpennies fit along a twelve-inch ruler. Check your estimate. 2
2. What is the distance between:
   - (*a*) Your thumb and little finger ends stretched to their widest? Do you know what this distance is called? 2
   - (*b*) The top of your kneecap and the ground when your leg is straight? 2
   - (*c*) The tips of your middle fingers when your arms are wide apart? 2
3. What is the length of your school desk? 3
4. How many times is the eye blinked in two minutes? Would it be better to count your own, or those of a friend? 4
5. How would you measure the distance around a bicycle wheel? 3
6. How much milk is there in a bottle of school milk? How much is there in the bottle your milkman leaves at home? 3
7. How could you measure the distance round your wrist or your waist? First guess and then check. 4
8. What are the three most important measurements of a brick? What are they in inches? What is the weight of a brick in ounces? Check these. 5

How many did you score out of 30?

inches

9 – *Air and breathing*



1. How long can anyone live without air?
2. Do we use all the air we breathe in?
3. Do all animals breathe? Do birds? Do insects? Do fish? Do trees?
4. How can we make sure that the water in an aquarium is aerated?
5. What do you know about the lung fish?

Things to do

1. Put your hands on your ribs and feel them move in and out as you breathe.

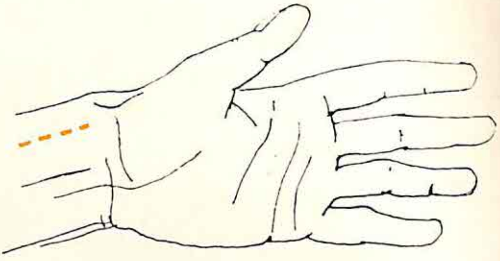
   Get your partner to say 'Go' and 'Stop' at the beginning and end of one minute while you count how many breaths you take sitting down. Now do the same after you have walked thirty yards quickly; after you have run thirty yards quickly; and after you have touched your toes twenty times. Why is it necessary to rest between each of the three activities? Make a table like the one below and record your results. Now do the same for your partner.

Number of breaths taken in one minute after:

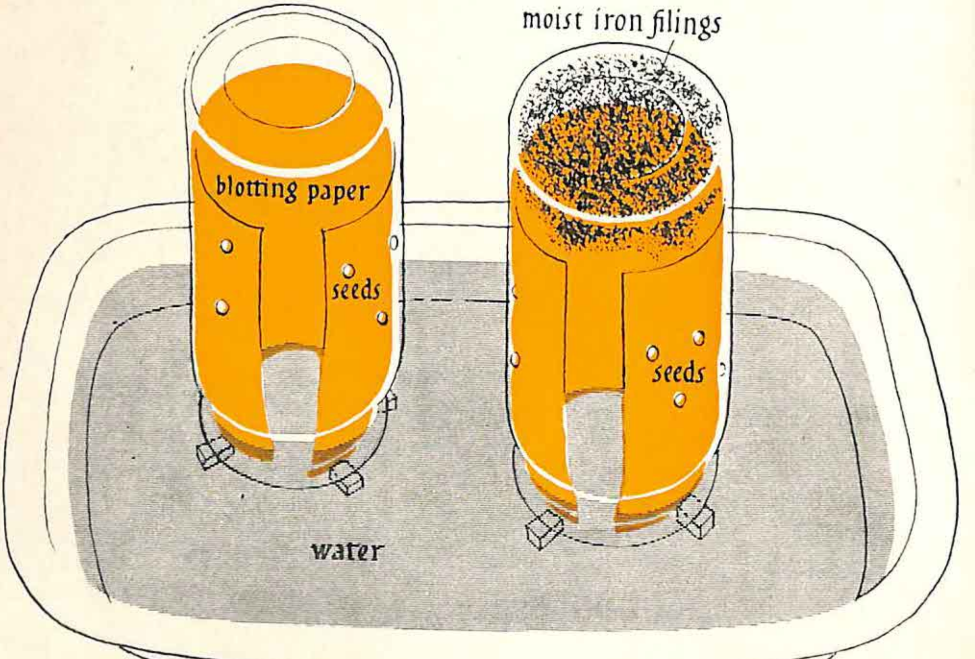
	sitting	*walking*	*running*	*touching toes*
myself				
partner				

2 Work with your partner to see how long he can hold his breath.

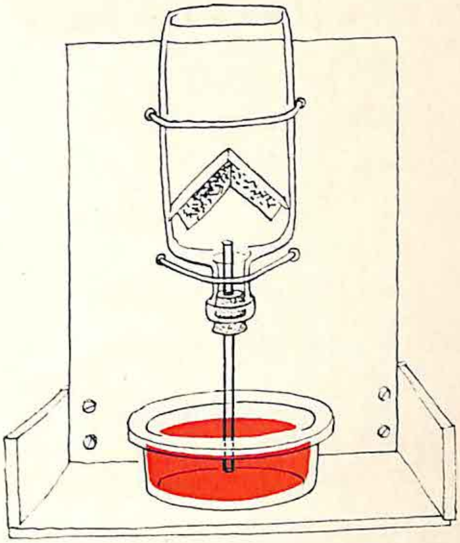
3 Make another table like the one above. Do all these experiments again but this time count your pulse beats. If you cannot find your pulse, put your hand over your heart instead.



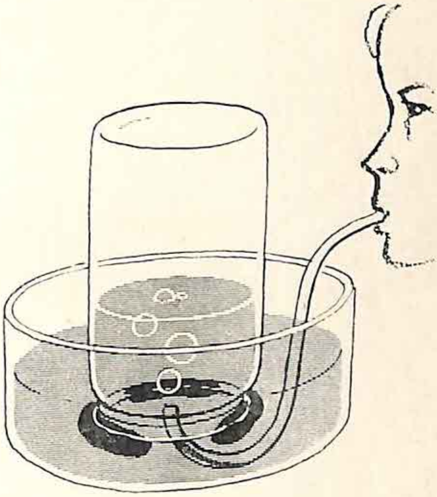
4 Look at the sketch carefully and work out how you can fix up this apparatus. The experiment will have to be left for a day or two. Is there any difference between the seeds in the two jars? If so, can you think why? (We have chosen radish seeds because they begin to grow quickly, but you can use other seeds if you wish.)



5 Fold a strip of paper or thin cardboard to fit in a bottle. Spread glue over the paper and put some iron filings on the glue and damp them well. Fix up the bottle, glass tube, and tank as shown. What happens to the water? Why? Remove the cork and put a piece of lighted string in the bottle. What happens? How have the iron filings changed?



6 Fill a large jar full of water and invert it in your tank so that it rests on two pieces of plasticine. Breathe through the rubber tube until all the water has been replaced. Lift the jar out and hold with the mouth downwards. Test with a lighted string. Why does the light go out? Try the experiment a few times.



7 Fill a glass tumbler with cold tap water and leave it either in a warm room or over a hot radiator. What are the bubbles formed on the inside of the glass below the surface of the water?

Things to remember

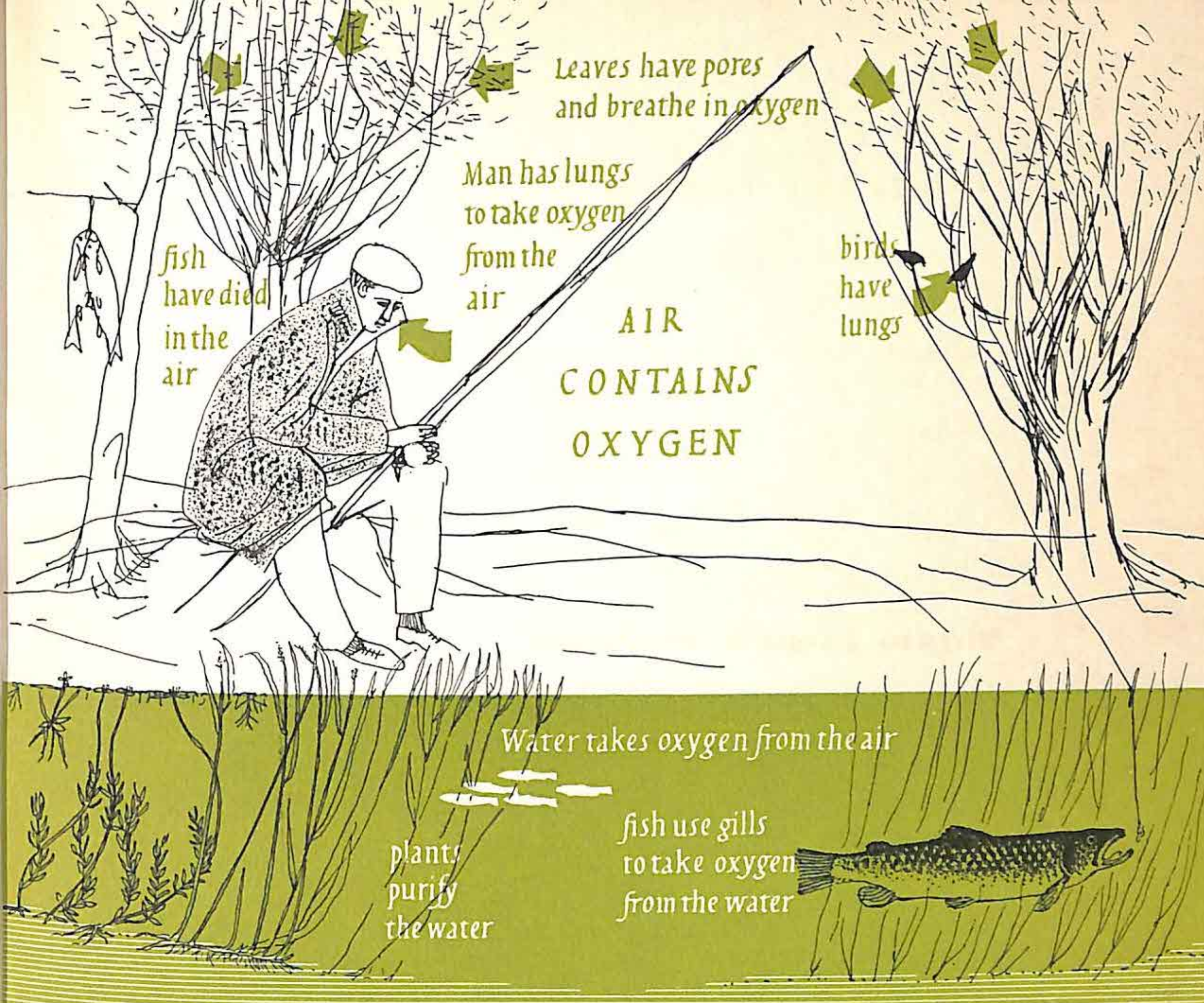
Air is needed for breathing by all human beings, all animals, and all plants. The part of the air used is called oxygen. You cannot live for more than a few minutes without oxygen. Oxygen cannot be seen. It is a colourless gas. Oxygen is taken from the air when iron rusts. Air is dissolved in water. Fishes take air into their bodies through their gills. When tadpoles turn into frogs, they lose their gills and breathe through lungs as we do.

In your Science Notebook

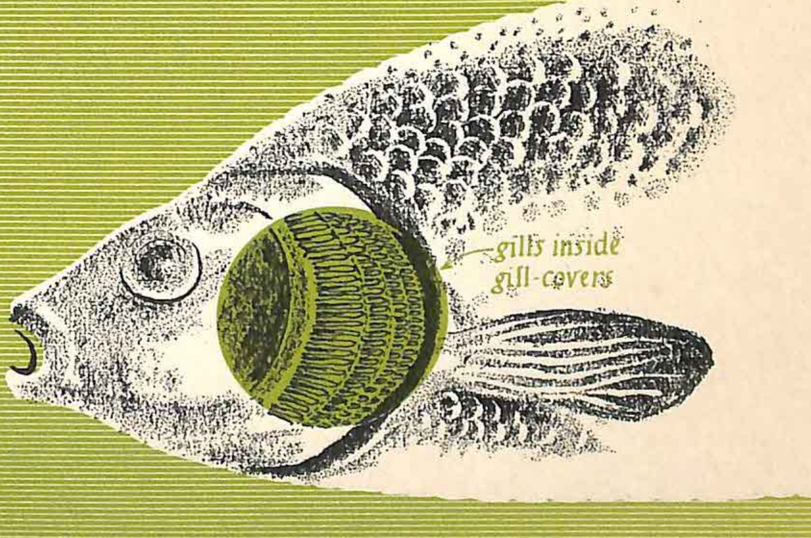
Copy out your tables for Experiments 1 and 3.

Ask a grown-up to show you how to find the lowest, the highest, and the average number of breaths from the results of all the children doing Experiment 1.

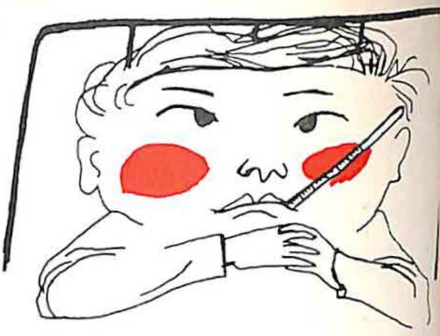
Draw sketches of your Experiments 4, 5, and 6 and write a description of them in the way you were shown on page 17.


Leaves have pores and breathe in oxygen
Man has lungs to take oxygen from the air
fish have died in the air
birds have lungs
AIR CONTAINS OXYGEN
Water takes oxygen from the air
plants purify the water
fish use gills to take oxygen from the water

Fish take in water through the mouth and pass it over blood-vessels in the gills, which take out the oxygen.



10–*Heat and cold*



1. What temperature is comfortable for a classroom?
2. Where should a person be who has a high temperature?
3. What are the hottest and the coldest things you know of?
4. How does a mother test baby's bath water?

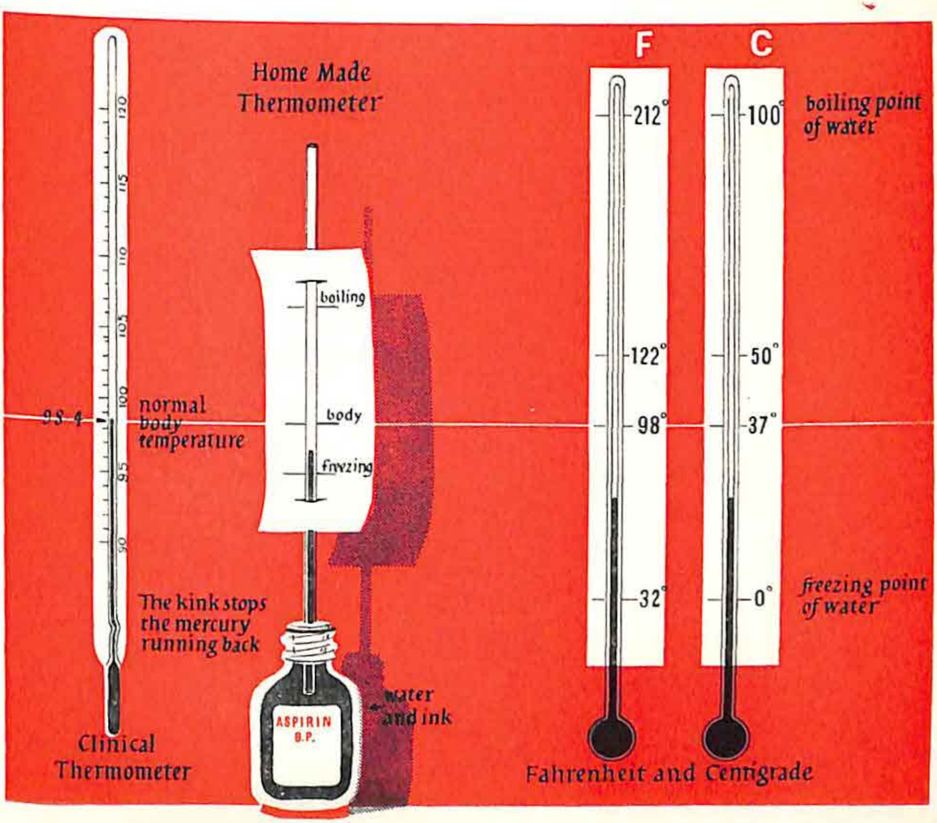
Things to do

1. Get three basins and put hot water in one, warm water in the second, and cold water in the third. Put your hand in the hot water. (Don't have it too hot!) After a while put the same hand into the warm water. Now put your other hand into the cold water and then into the warm. This experiment shows you that you cannot rely on your touch to measure heat and cold. A scientist must be more accurate. You need to measure exactly and your hand cannot do this.

2. A thermometer tells us how hot or cold a thing is. The sketch shows you how to make one for yourself. Put your hand round the bottle and mark the height to which the column of water rises in the tube. Compare the temperature of your hand with that of your partner. You can also blow hot air from your mouth on the bottle and find the difference in the temperature of your breath. Now do the same, putting the bottle in hot, then cold water. Why does the level of the water change with heat and cold?

3. Sometimes, records of temperature in various towns appear in your daily newspaper. Cut them out and put them in your Science Notebook.
4. Keep daily records of the temperature inside and out. Try to invent a neat table in which to record them.
5. Try to see as many different kinds of thermometer as you can. What is a clinical thermometer? Why are there less divisions on it than an ordinary thermometer? Why does the doctor put it under your tongue?

   Have you seen the thermometers on the school boilers? Ask if you may see them.



Things to remember

Thermometers record the exact temperatures of things. The substance in the tube expands on getting hot and contracts when it cools. The level in the tube therefore changes.

There are different kinds of thermometers used in school, home, and hospitals. Melting ice and boiling water are used to fix the marks on thermometers. Afterwards, other marks are fixed by measuring between these two.

In your Science Notebook

Make a neat drawing of the thermometer in your classroom. What kind of a thermometer is it?

Make a table to record the results of the experiments you have done.

Find the temperatures of the following and write them down in your notebook:
Your breath; water from the cold tap; the air outside; the air inside; the air above the hot radiator; the air in the school's boiler-room.

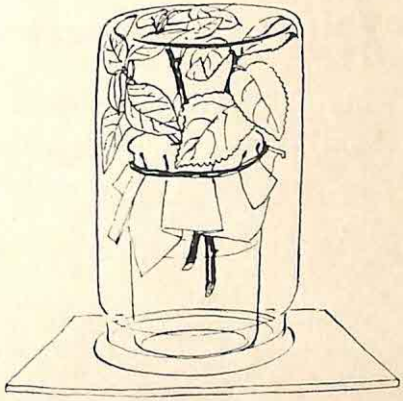
If you can borrow a number of thermometers, the children in a team could each do one of these and give the results to the other members of the group.

11 – *Water and plant life*

1. Why does a gardener use a watering can?
2. How do you think the watermelon got its name?
3. Name fruits which have much water in them.
4. Why do few plants grow in the desert? What sort of plants do grow there?
5. Why does a tree have roots?
6. Are raindrops always the same size?
7. How many other ways do you know in which human beings take in water apart from actually drinking water from the tap?
8. What is the difference between rain, sleet, and hail?

Things to do

1. Examine a plant for water. Pinch the leaf between your fingers. Cut the stem and look inside. Cut the root and examine it carefully.
2. Put some twigs with leaves on them in a jar of water and cover the top of the jar with brown paper. Put a bigger jar or a plastic bag over the first jar. Where have the drops of water on the inside of the large jar or bag come from? How are leaves similar to the skin of our bodies?



3 Put some pieces of carrot, celery, and potato on a tin lid and heat them strongly. Hold a medicine bottle filled with cold water just above the heated vegetables and collect little drops of water. Look carefully at what remains on your lid. It is called charcoal or carbon.

4 Compare mustard seeds grown on dry flannel and damp flannel. Plant two of your small plants, one in dry soil and the other in damp soil. Keep one dry and warm and the other damp and warm. Can a plant grow without water?

5 Put the stem of a freshly cut flower in water coloured with a little red ink and leave for a time. Are there signs that the water has travelled into the stem and the flower? Cut the stem across and look at it with your lens. Is it red in parts or all over?

6 Collect some green scum from a pond and look at it under your lens. Is it a plant?

These are only a few of the experiments which can be done with plants. Look for accounts of others in reference books.

Things to remember

All plants require water for growth. The water is taken in by the roots and is carried to all parts of the plant. Many plants, like fruit and vegetables, for example, contain more water than anything else.

Plants breathe out water vapour into the air through pores in the skin of the leaves. Human beings breathe out water vapour.

Purified water is necessary to keep people alive. Water is necessary for washing, cooking, etc.

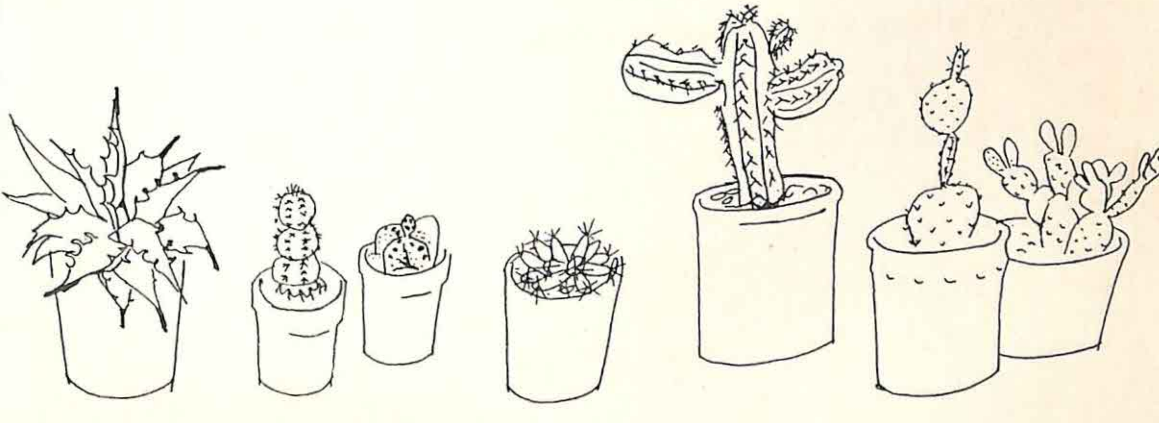
In your Science Notebook

Make sketches of your experiments about water and plant life.

Make columns for Experiment 4 and in them record the dates and results of your observations.

Find out all you can about the following: pores, fertilisers, evaporation, cacti. Write a sentence on each in your notebook.

Write down five different ways in which water is used inside your home and three ways outside.



Did you know that . . . ?

Wrongs put right!

An elephant is not afraid of a mouse.
An ostrich never hides its head in the sand.
A bull cannot distinguish a red flag from a blue one.
A bat is not blind.

National health

If you clean your teeth and keep them all, you will have 32 when you are grown up.

Good advice

A thrush's song has been translated as:—
Get up! Get up! Get up! Don't be late! Don't be late!
Time for tea! Time for tea! Run along! Run along!

How many are there?

There are twice as many insects in the world as all human beings, all animals and all other creatures added together.

Speed!

A humming-bird beats its wings 200 times every second.
A sparrow beats its wings only 13 times a second.

Sound in wind and limb

A cricket's ears are on its front legs. When it chirps, the noise is made by the rubbing of its wings together.

Waste not, want not

The kingfisher uses the bones of fish he has eaten to help to make his nest.

12 – How sounds are made

1 Which are the loudest and softest sounds you have ever heard?

2 How does a hearing aid help a deaf person?

3 Why do you hear the echo of your voice in a cave or cellar later than your actual voice?

4 Why does an animal prick up its ears?

5 Does sound travel through water?

6 Do fishes have ears? Do insects?

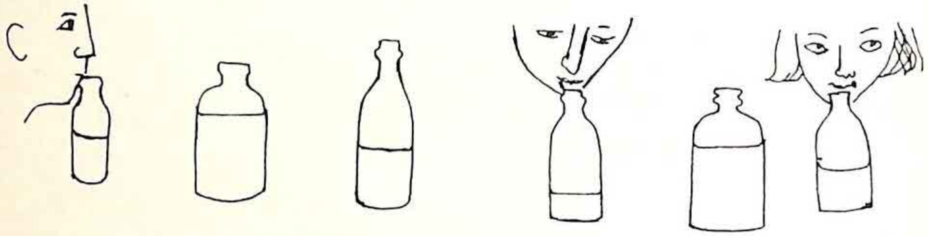
Things to do

1 Hold a wooden ruler tightly on the desk by pressing with your thumb on one end. Lift up the other end and let it spring back to slap the desk. Now hold it on the edge of the desk so that only half the ruler is used to do the same thing. Is there any difference in the sound? Try the same experiment using, for example, a table knife.

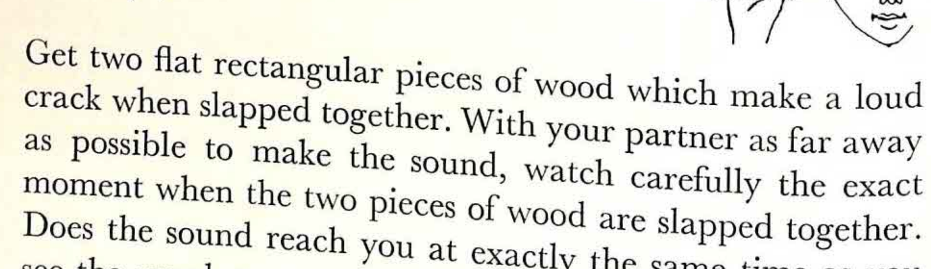
2 Stretch a piece of elastic or string between your two hands, pull the middle and let go. What happens to the elastic? How can the sound made in this way be altered?

3 Ask your teacher to lend you a tuning fork. Knock the prongs against your heel and put the end of the fork on the desk or use a wooden box for a sounding board. Have a look at the marks on the fork and see which note you are playing.

4 Blow across the hollow ends of keys or bottle necks to get different notes. What difference does the size of the hole make? What is vibrating (moving backwards and forwards) to make the sound? Pour water into the bottles and blow again across the tops. Do you get different notes?

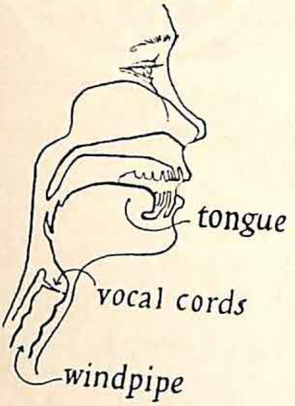


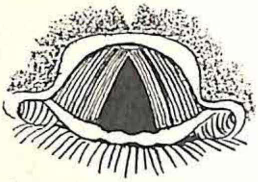
5 Get two cocoa tins without lids (or two ice cream cartons). Make holes in the centre of the bottoms and knot a long piece of string through the holes. Choose a piece of fairly thin string, about ten yards long if you can. Get a partner to hold one of the tins and pull the string just tight. Now speak softly into the tin and ask your partner to answer. How is the sound carried from one to the other?

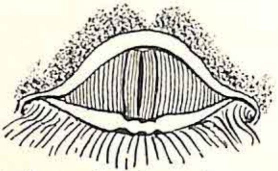


6 Get two flat rectangular pieces of wood which make a loud crack when slapped together. With your partner as far away as possible to make the sound, watch carefully the exact moment when the two pieces of wood are slapped together. Does the sound reach you at exactly the same time as you see the wood come together? Does this experiment tell you anything about the speed of light and sound?

7 Hold a long pencil in your mouth and tap the end. Then grip the pencil with your teeth and again tap. Can you feel a difference? Why?

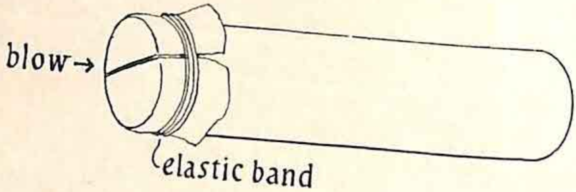



vocal cords relaxed-silent


vocal cords closed-speaking

8 Hold your finger and thumb lightly against your Adam's apple. Now sing a note. Can you feel the vibrations? Press gently and listen to the note altering.

9 Cut two suitable pieces from a rubber balloon and fasten them over the top of a glass tube or a cotton bobbin so as to imitate the vocal cords. Blow between the stretched rubber to make different sounds.



10 Put cotton wool in your ears and a ticking watch on your forehead. Now take out the wool and put the watch on the table. Put one ear to the table at various distances from the watch. Does sound travel through bone or wood?

Things to remember

When anything vibrates quickly, it gives out a sound. Our voices are caused by air from the lungs vibrating the chords in our throats.

Sound travels more slowly than light. The clap of thunder follows the flash of lightning, although both happen almost together.

A violinist makes his notes by vibrating the strings with his bow and by using his fingers to alter the notes by shortening or lengthening the amount of string vibrating.

In your Science Notebook

Collect as many pictures of musical instruments as you can. Draw them and try to explain how the sound is made.

Collect as many words as you can which describe different sounds; for example, howl, buzz, hum, and so on. Have a competition to see who gets most.

Try to find out what vibrates when a sound is made by a bell, a whistle, a piano, a drum, and wood being sawn.

Find out the names of the musical instruments on the page before last. Can you group them according to the way they are played?
Strings, played by scraping or plucking.
Woodwind, played by blowing through wooden tubes.
Brass, played by blowing through metal tubes.
Percussion, played by striking.

How to find out if you are good at doing experiments

	marks
1. Can you balance four twelve-sided threepenny pieces on top of each other but on their edges? You will need the patience all good scientists have.	3
2. Hold a penny with your left forefinger so that it stands on its edge. Now flick it with your right thumb and allow it to spin by itself. If you can make it spin for more than five seconds, give yourself	2
3. Can you prove whether the following are true or untrue?	
(*a*) A penny will not roll for more than twelve inches on a table top?	2
(*b*) A rubber ball dropped from a height of two feet will rebound one foot?	2
(*c*) A coin tossed fifty times will come down twenty-five times heads and twenty-five times tails?	2
4. How could you find out how many unworn pennies balance a quarter of a pound of tea without using real scales?	3
When you have done this, can you say how many pennies weigh one ounce?	1
5. How could you prove that two threads of cotton twined together are stronger than one thread?	3
6. How could you prove that the answer to a short division sum was correct by doing a multiplication sum?	2
7. How could you prove whether it is true or untrue to say that there are more brown-eyed children in your school than blue-eyed?	2
8. Can you balance a ruler standing on its end on your forefinger for five seconds?	2
	24

How much more do you know? **Test two**

1. Choose one of these words to fit each sentence and write out the completed sentences.

snow
oxygen
lighter
pressure
top
expand
temperatures
ice
light
water

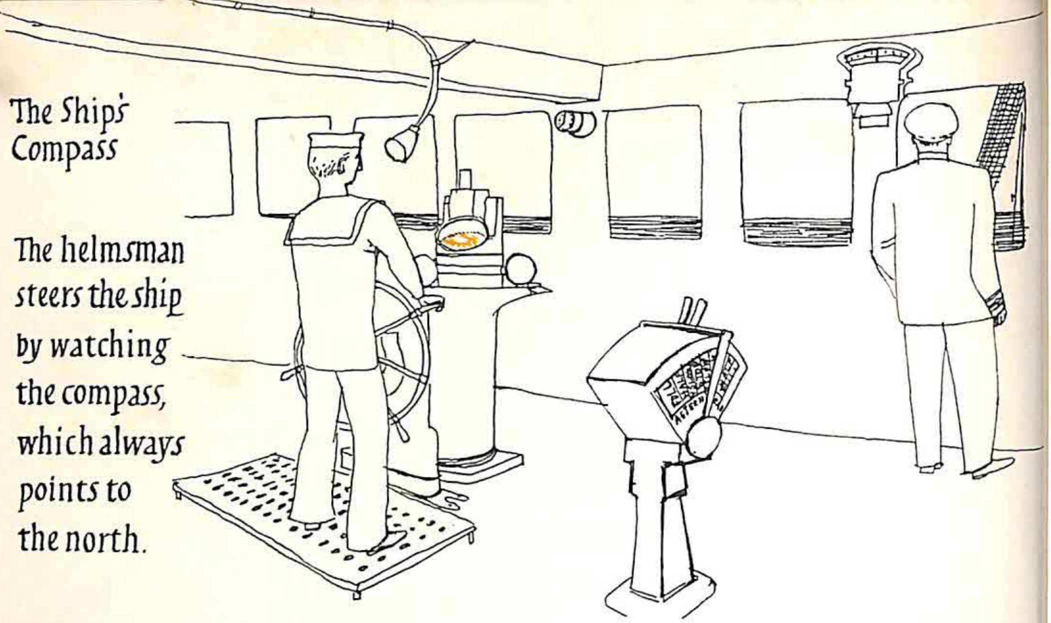
All gases, liquids, and solids ——— on heating.
Many plants contain more ——— than anything else.
Hot air is ——— than cold air.
——— will make snow and ice melt.
The ——— of a pond freezes first.
Twelve inches of ——— make about one inch depth of water.
——— and steam are used to fix the marks on a thermometer.
——— travels more quickly than sound.
Fishes take in ——— through their gills.
Thermometers tell us the exact ——— of things.

2. Make a list of the things you see have changed outside after it has rained heavily.
What differences are there when it has snowed heavily?

3. Write out everything you would do to make an acorn grow into a little oak tree.

4. Are the following true or false:
   (*a*) Air expands on heating.
   (*b*) Water runs more easily through clay than sand.
   (*c*) Hail, ice, sleet, and snow are really water.
   (*d*) Sound is made by vibration.
   (*e*) Both plants and human beings breathe out water.

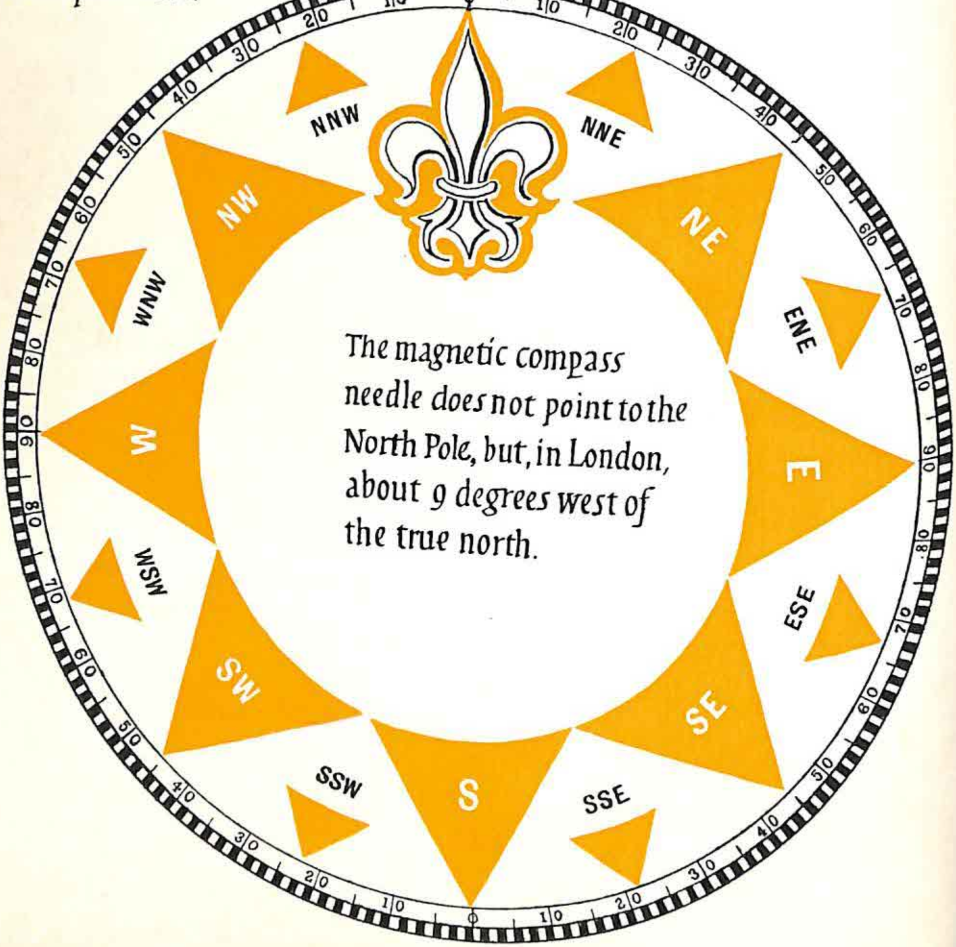
The Ship's Compass



The helmsman steers the ship by watching the compass, which always points to the north.

The compass is fixed in a housing so that no matter how much the ship pitches or rolls, the compass card is always kept steady and horizontal.

The Compass Card



The magnetic compass needle does not point to the North Pole, but, in London, about 9 degrees west of the true north.

13–*How to make your own compass*

1. Have you a magnet at home? If so, what shape is it?
2. Of what is a magnet made?
3. What different shapes and sizes of magnets are there?
4. What are the uses of magnets?

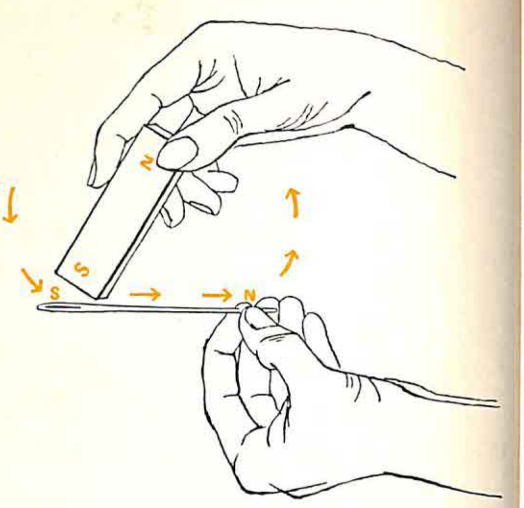
Things to do

1. Use a magnet to find out whether it will attract a penny or a shilling.
   Try your magnet with different coins, any pieces of metal, a tin can, wood, rubber, pins, paper, and glass.
   Make two columns in your Science Notebook and record your results, showing which are and which are not attracted by magnets.

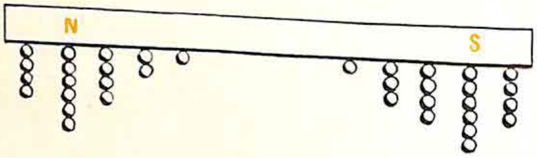
MAGNETIC	NON-MAGNETIC

2. Will a magnet act through paper, glass, wood, or water?
   Put some tin tacks, pins, or steel ball bearings on a sheet of paper and see if you can move them when you draw your magnet underneath the paper.
   Try the same experiment with glass and wood.

3 Make a large darning needle or a knitting needle into a magnet by stroking it only one way with a magnet as shown in the drawing. Draw it about fifteen times from one end to the other but never back again.
Prove that it is a magnet.



4 Do this experiment to prove that a magnet is stronger in some parts than others. The drawing shows how tacks or ball bearings are held by a magnet. The strongest parts are called the poles of the magnet. There are two poles—the north pole and the south pole.



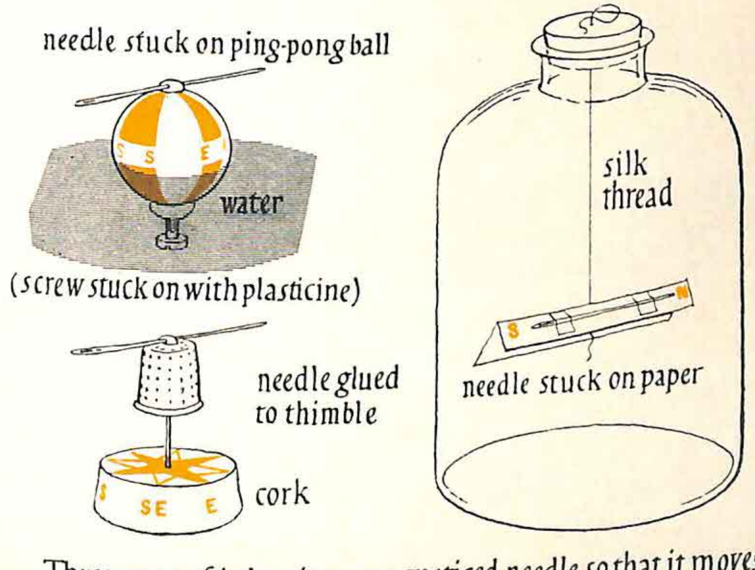
5 Magnetise a needle. Float it on the surface of the water in a deep saucer. To do this, put a dry needle on a small piece of floating blotting paper and remove the paper when it sinks. Other ways are to float the needle on a flat cork or on a ping pong ball. How can you use a fork to float a needle on water? Where does the needle point to? Why? What name could you give to what you have made? Could you make a better one at home so that it moves freely in a different way? Some ideas are given on the page opposite.

6 Magnetise two needles and make sure that the pointed ends are pointing the same way when you stroke them with your magnet. If you stroke them with the South pole of the magnet from eye to point, your needles will have North poles at their points.

Float them on water. What happens to the needles when the two pointed ends come together? Move one round so that the eye of one and the point of the other come together. What happens? Try your needles in different positions.

7 Make a small ship out of paper and put a magnetised needle in it and float it on water. Which way does it point? Show that you can pull the ship along with a magnet.

8 How could you find out which magnet used in your class is the strongest and which is the weakest?



Three ways of balancing a magnetised needle so that it moves freely

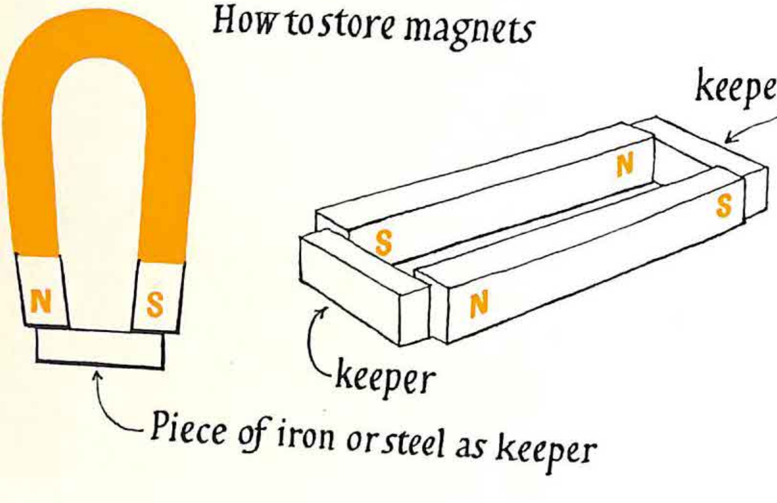
Things to remember

There are different kinds of magnets. There are bar magnets, horse-shoe magnets, and U-shaped magnets, and even electric magnets. They are made of iron or steel.

Magnets will not attract silver, copper, wood, or glass. Magnets will attract iron or steel things. Steel is almost pure iron.

A magnet can act through thin layers of paper, glass, wood, and water.

When a piece of iron or steel which has been magnetised can move freely, it points to the magnetic North and South.



A powerful magnet is used in hospitals for removing pieces of metal from the eye.

The largest magnet in the world is said to be one in California, U.S.A., which can lift 10,000 tons. This is about the weight of 200,000 children.

Did you know that . . . ?

The largest hailstone measured was 17 inches all round and weighed 1½ pounds.

The fastest wind in the British Isles was in the Orkneys at 125 miles per hour, but elsewhere winds of more than 200 miles per hour have been recorded.

A bottlenosed whale can stay under water for 120 minutes, a seal for 15 minutes, a dog for 4½ minutes and a human being for 3 minutes.

A leopard can jump more than 8 feet in height.

The fastest animal is the cheetah which can travel at 70 miles an hour.

The tallest animal is the giraffe. One was 10 inches higher than a London bus and measured 18 feet 5 inches in height.

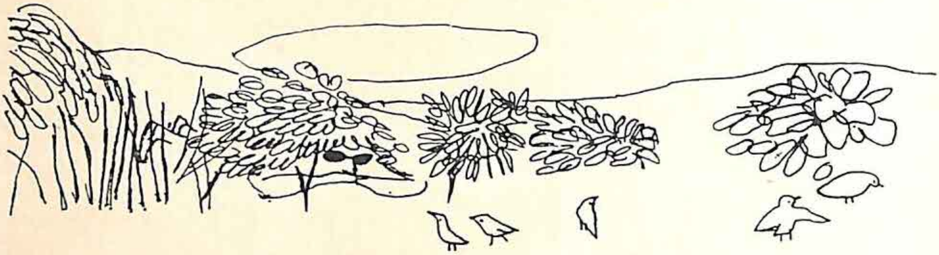
The oldest elephant lived 70 years; a horse has lived more than 50, a dog 34 and a cat 32.

Sound travels 4 times more quickly through water than through the air.

An echo will be heard in one second if the reflecting wall is 550 feet from the listener.

There are water-lilies on the River Amazon in South America whose leaves are 21 feet across and whose flowers are 15 feet across. Compare these measurements with the size of your classroom.

14 – The scientist looks at life:



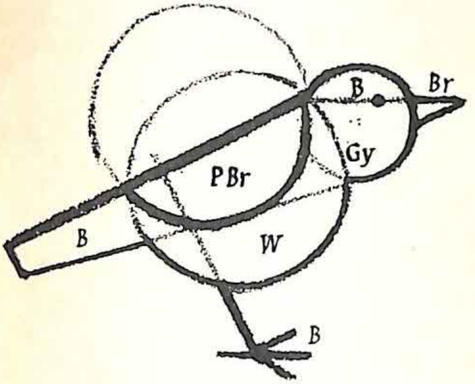
Birds

1. How many birds have you seen and recognised recently? What are their names?
2. How many different kinds of feathers has a bird? What are their uses?
3. Why does an eiderdown keep you warm in winter?
4. What are the chief differences between a bird and you?
5. In what ways do some birds help farmers? In what ways do other birds cause damage? What is migration?

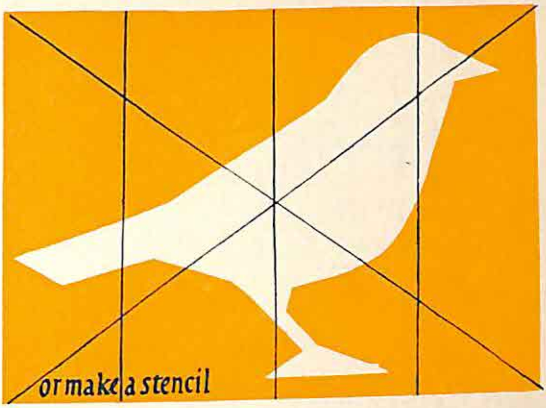
Things to do

1. The best way to learn about birds is to watch them. You will need to be very quiet. Keep very still and note everything that happens.

   Jot down the colour and markings of the bird by using letters and small circles like those in the sketch. Carefully look at its beak, its legs and feet. How big is it? Does it hop, walk, or jump? Has it plain or marked feathers? Where does it live? What is its song like?

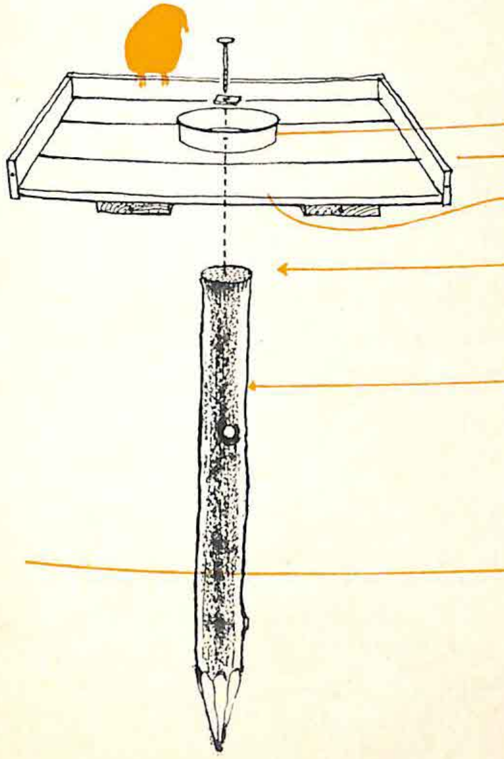


Draw round coins or lids



B black	R red	G green	P pale
Bl blue	O orange	Gy grey	D dark
Br brown	Y yellow	W white	Sp speckled

2 Make a bird bath, a bird table, or feeding boxes and try to get the birds to come to your garden.

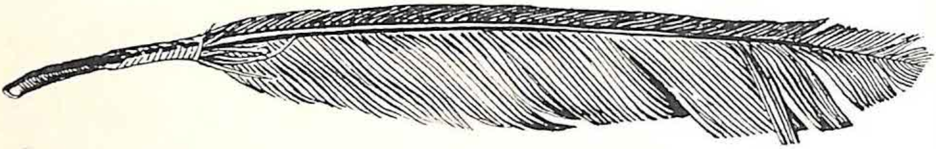


large nail
washer
polish tin or lid with rounded edge
strips of wood (4)
end of packing-case, or plank

saw off as straight as you can

branch, 1 inch thick at least –
sharpen and drive into the ground

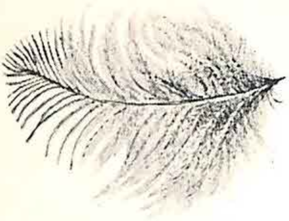
knock the nail part through the tin
and the board before fixing

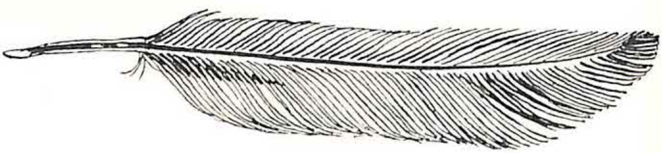


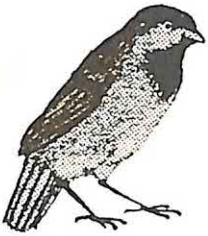
3. Collect different kinds of feathers. Look at them carefully and draw them. Bend the shaft backwards and forwards. Of what is the rest of the feather made? Why are the feathers of different shapes?

4. Find a nest and watch it during the whole time the bird is laying and hatching. Keep a diary or calendar of everything that happens. Do not take any eggs. You will learn more by allowing all the baby birds to be born.

5. Make tables in your Bird Book like those shown and collect as many different drawings from living birds as you can.

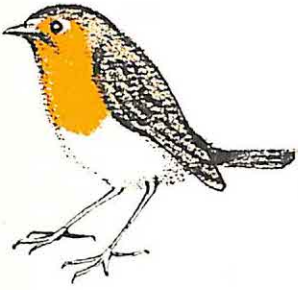






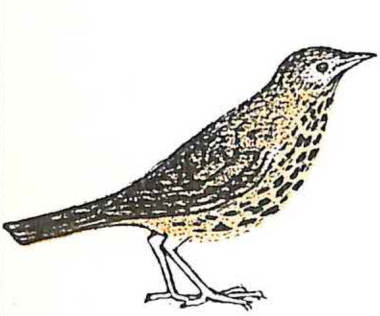
House Sparrow

NEST. Anywhere outside house or in trees
EGGS. Grey or brown. About 5
APPEARANCE. Black breast and throat.
Brown and black wings. Grey breast.
Impudent. Hops. 6 inches long
FOOD. Seeds and insects
SONG. Chee-up



Robin

NEST. Anywhere, including unusual places
EGGS. Freckled white. 4-6
APPEARANCE. Red breast, throat and
face. White tummy. Olive brown back
and wings. Friendly. 5-6 inches long.
FOOD. Insects like daddy-long-legs,
earwigs, butterflies, spiders, worms, and scraps
SONG Tic-tic-tic. Tzwee



Song Thrush

NEST. Bushes or tree
EGGS. Bright blue with black spots. 4-5
APPEARANCE. Olive brown, lighter breast
with dark streaks. Long tail. Good
walker and fast runner. 9 inches long
FOOD. Worms and snails
SONG. Long, varied, tuneful

Things to remember

Nearly all birds can fly. They are covered with feathers which they use for flying or to keep them warm. Birds have the highest temperature of all animals. They are light and have strong bones. They fly easily because they are streamlined. The young are born from eggs. Birds breathe through lungs and have good eyesight. Birds can live in any climate from the North Pole to the hottest countries because weather does not affect them—but shortage of food does. Birds are enormous eaters. Some can eat their own weight in food every day. Birds differ in many ways. Some have webbed feet for swimming, others have very long legs. Their beaks and claws are shaped so as to allow them to live on different kinds of food.

Bird facts

The fastest flyer is said to be a racing pigeon which travelled at 94 miles per hour.

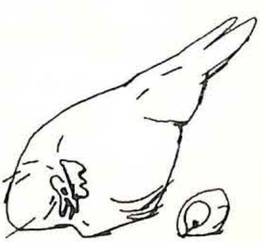
The largest egg is that of the ostrich which can be 7 inches long and equal to 17 hens' eggs.

During the twenty weeks in which they are migrating, Arctic terns travel 20,000 miles.

The smallest bird, the humming-bird, is about two and a half inches long.

In June, a robin sleeps about 5 hours but in December it sleeps $14\frac{1}{2}$ hours.

A hen cannot see with both eyes together but must turn its head to each side to use each eye in turn.



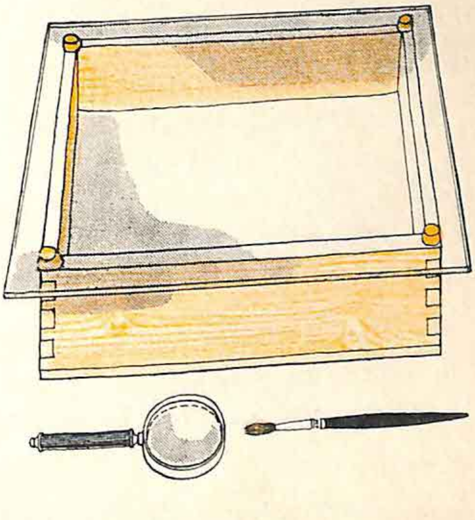
15–The scientist looks at life: The silk moth

1. How many insects do you know?
2. Why is the silkworm useful to us?
3. Which insects are harmful to us?
4. How many different kinds of cloth do you know?

Things to do

1. Ask your teacher to find out an address from which you can buy silkworms' eggs. They are very cheap.

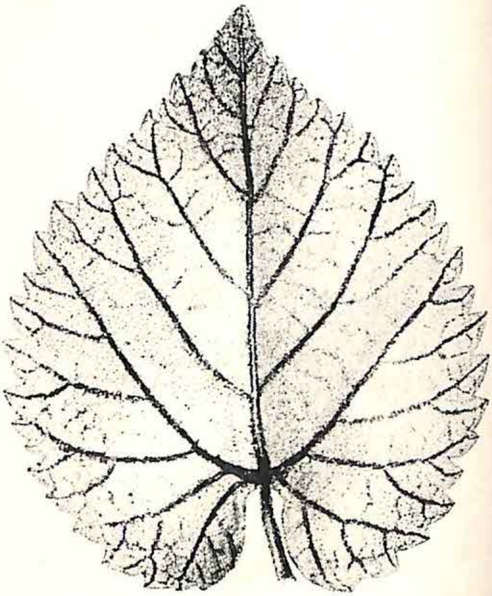
2. Make a box out of wood and get a piece of glass to fit the top. Put four pieces of Plasticine at the corners to allow air into your box. Line the box at the bottom with cardboard to help you keep it clean. An alternative is a cardboard box covered with cellophane with air holes punched in the box.



3 Examine the eggs under your lens. Are they like tiny hen's eggs? In what way are they different?

4 In spring, put your eggs in the box in a warm place. If you wish to move them, use a clean, soft paint brush. Put down the date when your first caterpillar appears.

5 Silkworms usually feed on mulberry leaves but you can buy eggs from moths bred on lettuce leaves. Remember to change the leaves daily or your worms will die. Make a note of the number of days it takes them to grow half an inch, an inch, an inch and a half, and so on. Through your lens watch them eat. Make a note of how many times a caterpillar loses its skin and whether it ever stops eating. Be alert and note all changes which happen, and write a note about them.



6 Examine a fully-grown caterpillar. Draw it in your notebook. Use your lens to see its legs. How many are there? Are they all the same? Look at its mouth. How does it eat the leaf? Can you see anything down the side of its body? Get a book from the reference library and find out about any part of the caterpillar you cannot explain. Watch how the caterpillar gets along. Write down the dates when the caterpillar changes its skin.

7 Put some twigs in your box to help the caterpillar to spin its cocoon. Watch carefully how it does this. Does it eat now? How long does it take to spin a cocoon? Where does the silk come from?

8 Wait for the silk moths to come out of your cocoons. Take an empty cocoon and soak it in warm water. Now pull off the silk and wind it round a cotton reel. Can you find its length?

9 Examine the moth. How many parts to its body? How many legs? How many wings? Can it fly?

10 Get a book on insects out of the library and learn all you can about these interesting creatures. You can easily rear many of the British butterflies and moths and keep a record of their lives and habits like the scientist does.

Things to remember

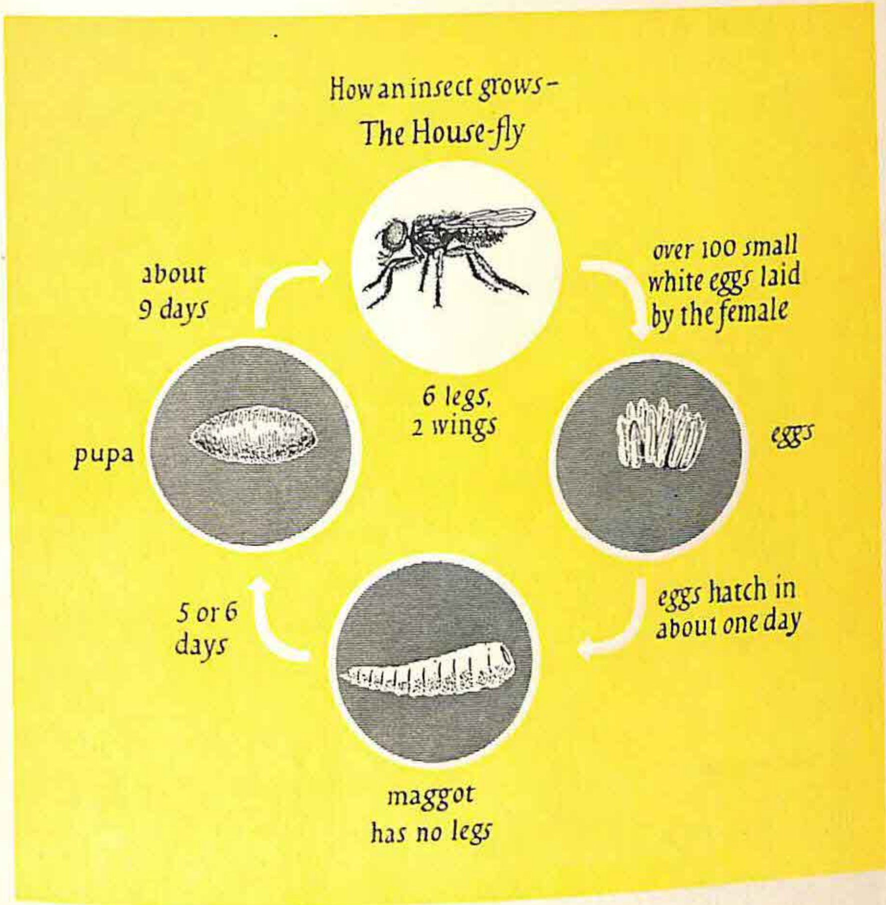
Most life begins in an egg of some kind. The silk moth's eggs are usually laid on mulberry leaves and hatch out in nine to ten days. Tiny black caterpillars come out and begin feeding almost at once. They grow very quickly and move their mouths backwards and forwards along the edges of the leaves, chewing as they go. The caterpillar breathes through tiny holes along the side of its body. As it grows bigger, its skin becomes too small and it casts it four times.

When it is ready to change into a pupa, the caterpillar stops eating and finds a place to begin spinning its cocoon.

It spins silk from a small tube near its mouth and, by moving its head round and round, makes a silken, oval home for itself. When it comes out of here, it is a moth.

The silk moth cannot fly. The female moth lays from 300 to 500 eggs and then dies and the life cycle of the silk moth begins all over again.

The Chinese used the silk thousands of years ago and it is still used as pure silk. The Coronation robe of Queen Elizabeth II was made from silk made by the silk moth. It takes 3,000 cocoons to make 1 pound of silk. One cocoon often contains more than half a mile of silk thread.



Kill that fly!

A female house-fly lays about 900 eggs during her lifetime, usually in manure or decaying things. Each fly can carry thousands of germs to our food on its hairy body. We should try to keep down the fly population by covering food, by keeping lids on dustbins, and by destroying their breeding places. Flypapers, poisonous sprays, powders, and cards can help us to kill these disease-carrying pests.

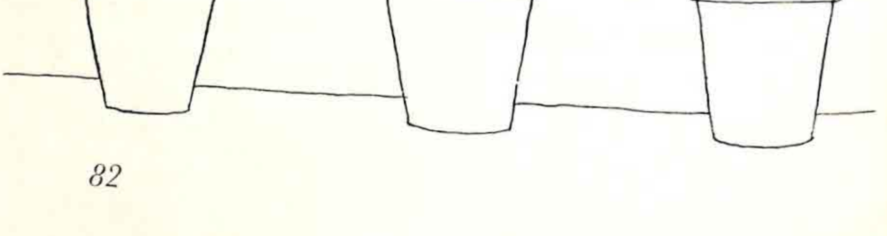
16 – *How seeds grow*

1. How is a seed like an egg?
2. How many different plant seeds have you seen?
3. How do seeds manage to get into the soil to grow?
4. Where in the plant are the seeds stored?
5. Why does an oak tree have so many acorns?

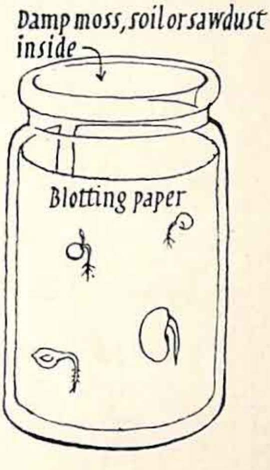
Things to do

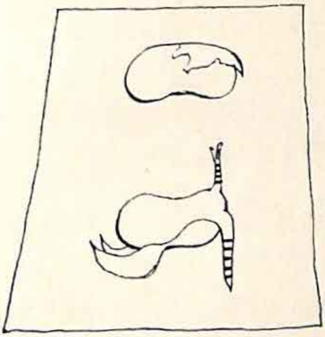
1. Soak some bean seeds in water overnight. Draw the seed in your notebook. Squeeze the seed between your fingers. Where does the water come out? Take off the seed coat carefully. Draw what you see inside. Examine other seeds and see if they have the same parts.

2. Try to grow an apple pip, a lemon pip, and an orange pip and if you are successful, carefully watch every stage of growth and keep records.



3 Line a jam jar with blotting paper and put in damp soil, moss or sawdust. Put seeds of bean, pea, radish, tomato, and onion between the paper and the jar. Where does the root appear first? In which direction does it grow? Turn some of your seeds upside down. What happens? In what way is the growth of your different seeds similar? Make a record of the growth of the bean by marking fine lines on the root and stem in black ink. Can you see where the root adds to its growth?

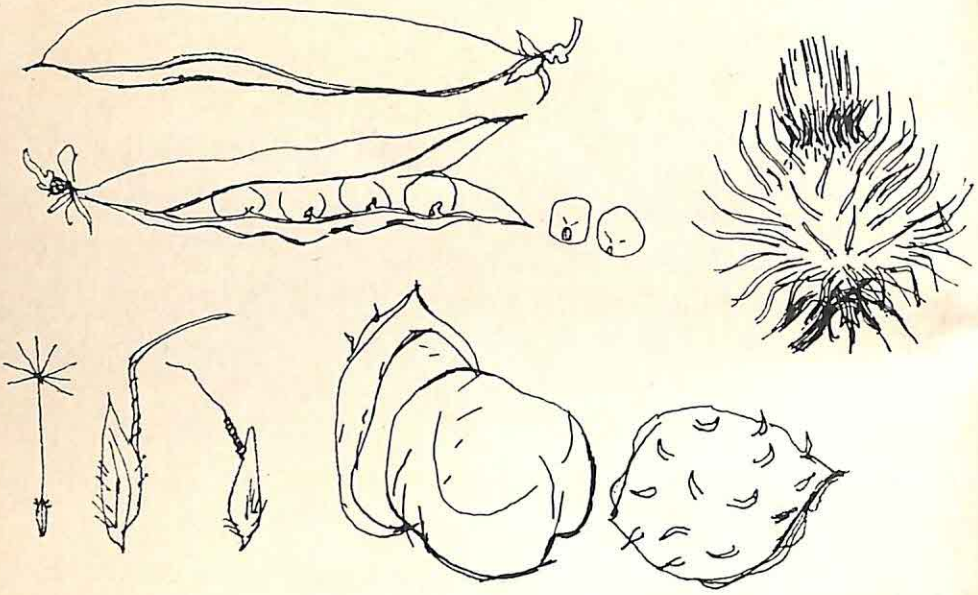




4 Plant radish seeds on the surface and at different depths. For example, 1 inch, 2 inches, 3 inches, etc., up to 12 inches deep in good soil in a jar.
How many grow? Which comes up first?
Make a record in your notebook of the date put in, the depth sown, and the dates when they appear.

5 Keep some young plants (e.g. beans) of about the same size in a dark cupboard. Water them at the same time as you water plants which have sunshine. How do they differ?

6 Make a collection of seeds of every kind and label them. Arrange them on the Science Table under headings; for example: used for food, used in children's games, have prickles, hooks, wings, parachutes, and so on.

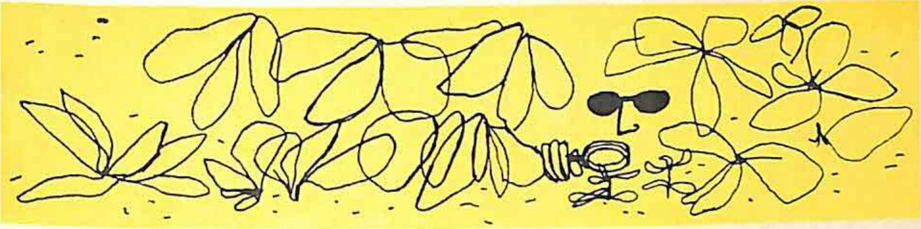


Things to remember

Seeds are needed so that new plants can replace the parent plant when it becomes old and dies. They need warmth, sunlight, and water to grow.

The young root breaks through the seed coat first and then the stem appears. Root hairs grow on the roots to help gather food from the soil. The root is a storehouse of food for the tiny plant until it can feed for itself.

17 – The scientist looks at life:



Flowers

1 Many flowers have interesting names. How many do you know?

2 Why do we like flowers? Is the plant helped in any way by having flowers?

3 Do you know the names given to scientists who study plant life?

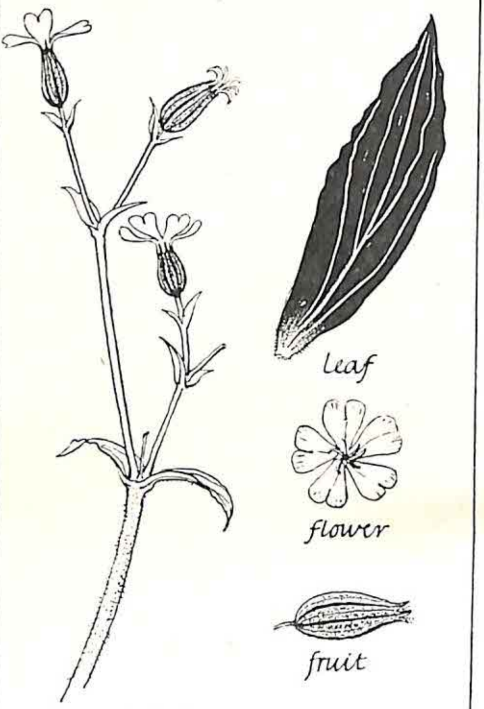
4 How many ways can you suggest by which we can take care of our countryside?

Things to do

1 Collect examples of wild flowers to decorate your home and school. Try many ways of arranging them. You might have a competition with your friends and ask a grown-up to judge. Change the water every few days and remove all the dead pieces.

2 Make flower stands to hold single flower specimens for you to examine. There are many ways of making labels and drawings to display your examples better.

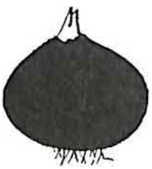
3 Make a wild flower survey of the area around your home and school. Use a flower reference book to find out the names of all flowers you find each month. When you go for walks, remember to look out for specimens you have not yet got. Can you arrange your flowers in families? Are any of your flowers like well-known garden flowers?



White Campion

4 Keep a flower book and draw your flowers like the one shown here. Look carefully at one complete plant.

How does the root help to hold the plant in the soil?
Do any roots store food?
How does the shape and strength of the stem help to get sunshine for the leaves?
Why do leaves have pores?
What is honey?
Which plants have green flowers?
Which flowers have scent?
Can you find the seeds?

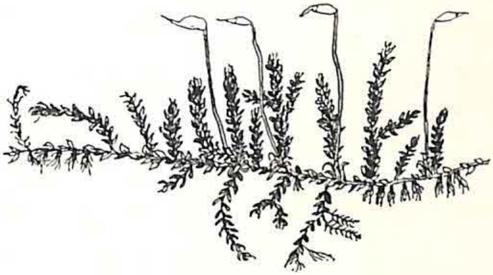


What is this?

5 On a sunny day, watch for the bees visiting flowers. What is pollination?

6 Make germinating boxes from such material as old roofing felt. Make a wooden trough and put into it a mixture of sand, good potting soil, and leaf mould. Grow plants from seed and write and draw what you learn in your notebooks.

7 Use an old sink tidy to keep ferns and mosses growing. Read about these in any reference book you can find and give a short talk to your friends about your discoveries. Don't forget to make some drawings and show them real examples as you talk. You are now the class specialist in ferns and mosses.

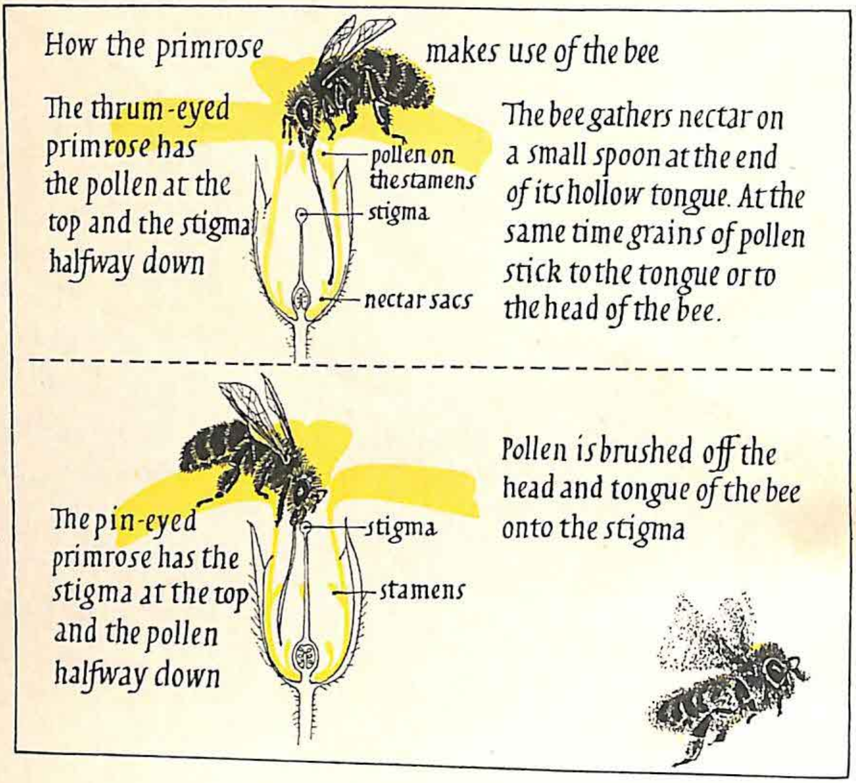


Things to remember

Plants do not move about like animals. They are fixed in the soil by their roots. The root takes up water, with food dissolved in it, from the soil to the other parts of the plant. Some roots, like turnip, dahlias, and carrots, store food.

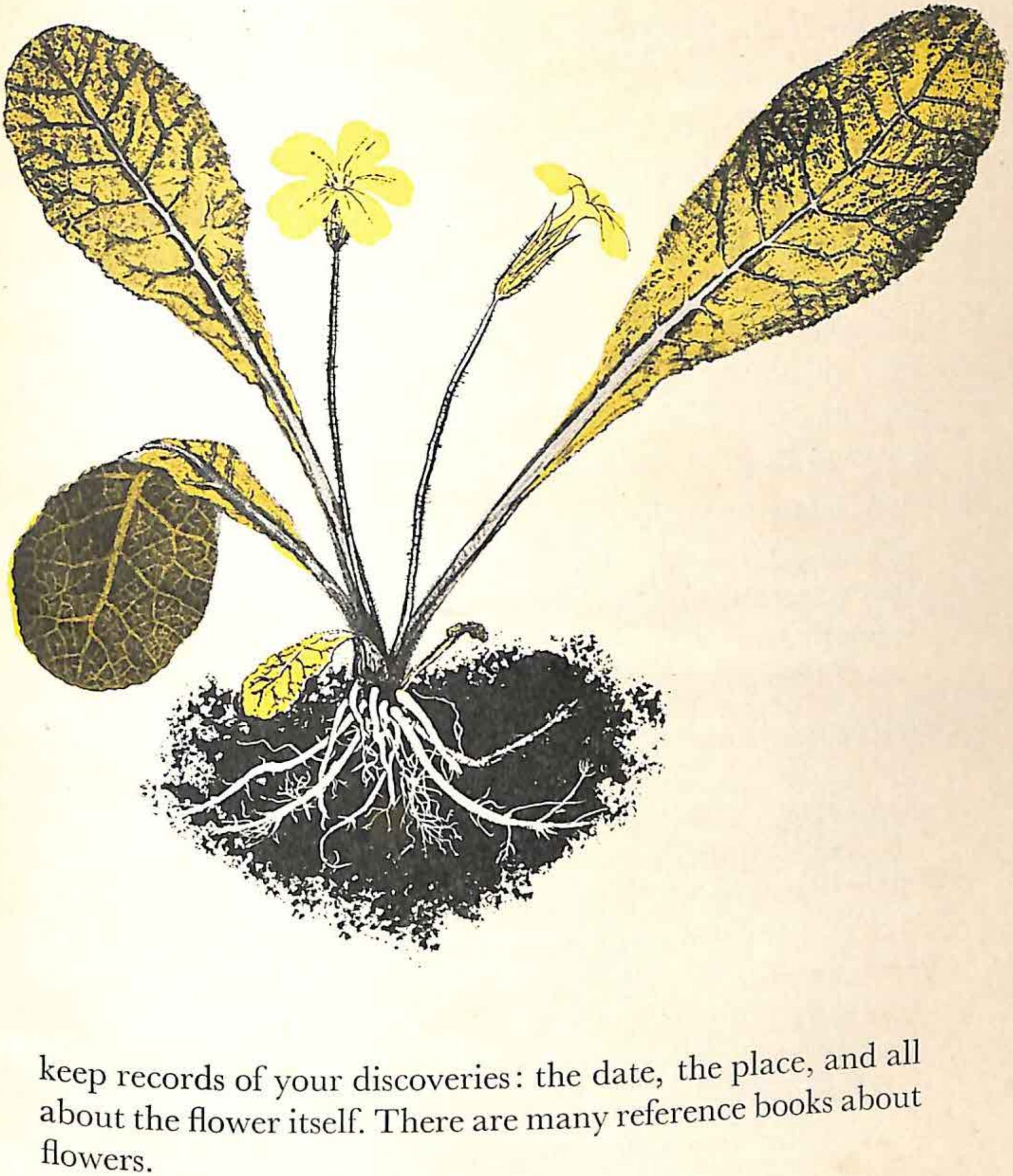
The stem of the plant holds up the plant so that the leaves can obtain sun and air. The stem is also the food tube from the roots.

The leaf uses sunshine and air to build up the food needed to keep the plant alive. The leaf has pores which get rid of any moisture.


How the primrose makes use of the bee
The thrum-eyed primrose has the pollen at the top and the stigma halfway down
pollen on the stamens
stigma
nectar sacs
The bee gathers nectar on a small spoon at the end of its hollow tongue. At the same time grains of pollen stick to the tongue or to the head of the bee.
The pin-eyed primrose has the stigma at the top and the pollen halfway down
stigma
stamens
Pollen is brushed off the head and tongue of the bee onto the stigma

The leaf also breathes in oxygen through its pores. The flower produces the seed from which new plants grow. By its colour and scent, it attracts insects. They carry pollen to other flowers so that they can make seeds. Seeds are sometimes scattered by the wind so that they fall on soil. Fruits contain seeds.

There are so many millions of plants in the world that they have to struggle to get some of their needs. You will find plants doing all sorts of remarkable things to succeed, and even trying to stop other plants from growing. You must look for flowers all the year round and make drawings and



keep records of your discoveries: the date, the place, and all about the flower itself. There are many reference books about flowers.

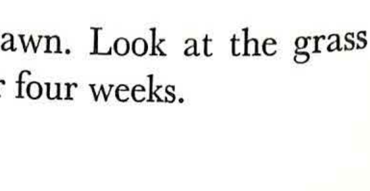
The world is made beautiful with its gaily-coloured flowers and would be a duller place without them. We must all do our best to love and protect our flowers.

18 – How the sun gives life

1. Where does the sun rise and set? Where is it at its highest point?
2. When do you feel the warmth of the sun most?
3. What happens when a cloud passes over the sun?
4. How do the sun's rays look when they pass through an opening in the clouds, through the spaces between the leaves of trees, or through the high windows in a church?
5. How many ways do you know of keeping cool in very hot weather? What colour of clothes keep you coolest? What colour keeps you warm? What kinds of clothes are worn by Eskimoes? By Negroes?

Things to do

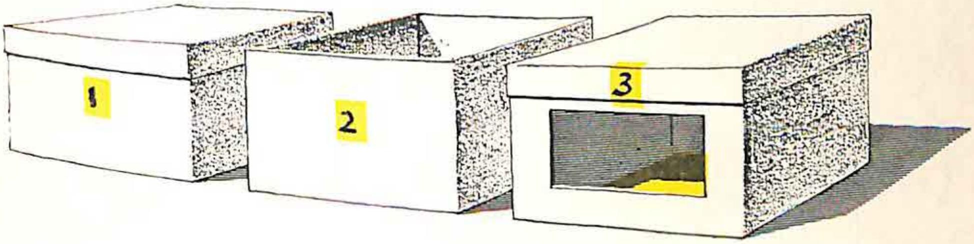
1. Get a magnifying glass. This is a lens thicker in the middle than at the sides. Point it to the sun and move it backwards and forwards until a very bright hot light appears on the back of your hand. See if you can light a piece of thin paper or cotton wool.



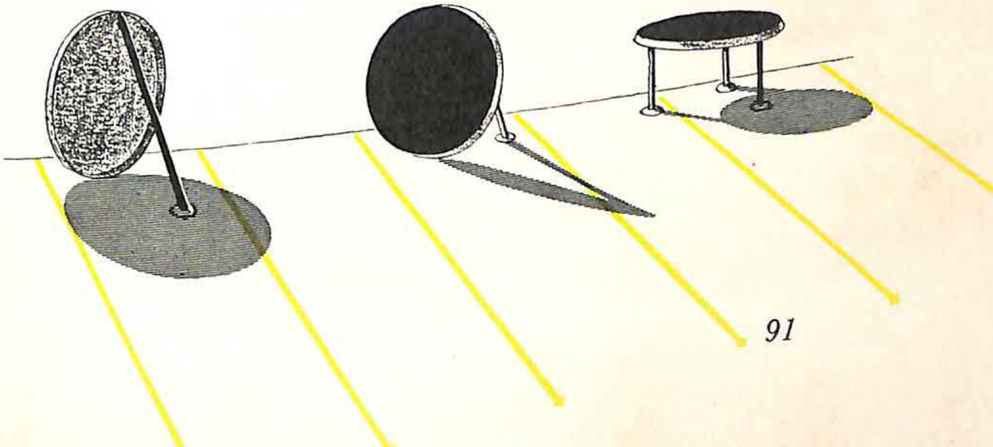
2. Put a brick over a piece of grass lawn. Look at the grass underneath after one week and after four weeks.

3 Look at two growing potatoes, one under soil, the other not covered with soil. What is the difference?

4 Plant some mustard seeds on pieces of damp flannel and let them grow. Leave a piece of flannel with some seeds in a cardboard box with the lid on. Leave another piece of flannel with seeds in another box with the lid off. Cut a window out of the end of a third box with its lid on and put the flannel and seeds inside. Do the seeds grow differently? Can you explain this?



5 Get two fairly large tin lids and paint them with black paint. When the paint has dried, put them outside, leaning on sticks in such a way that one of the lids is receiving the sun's rays as directly as possible and the other receives them slanting. Leave the tins for ten minutes. Which gets hotter? Try your tins in various ways in sun and shade. Why does the ground get warmer in places where the sun is directly overhead?

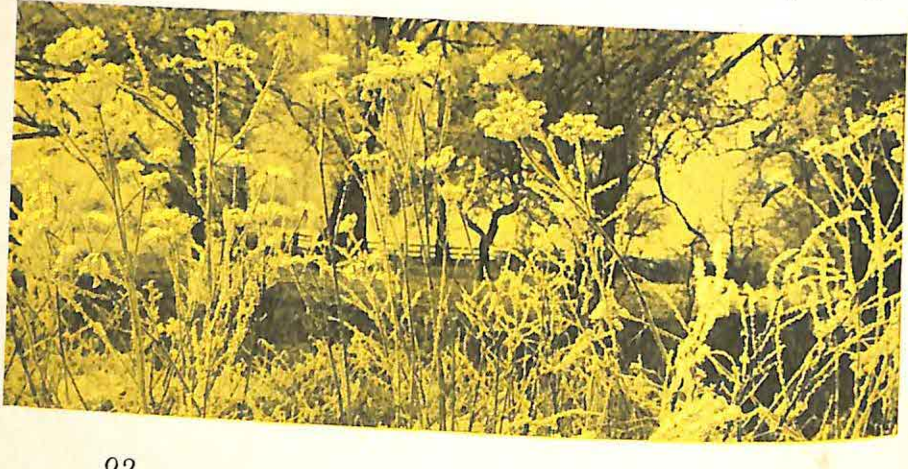


6 Place a stick upright outside early in the morning and measure the length of its shadow. Put a thermometer by the stick and measure the temperature. Do the same thing at different hours of the day before, at, and after noon. Make a record in your Science Notebook of your results.

Things to remember

The sun sends light and heat to the earth. The earth is warmed by the sun's rays. The sun's rays come to the earth in straight lines without heating the air. These rays have to travel 93,000,000 miles. As soon as the rays meet solid things, they give them warmth. Some things are warmed more than others. When the sun's rays strike direct, they warm things more than when the rays are slanting. This is one of the reasons why it is colder in the morning and evening than it is at noon.

Plants need light to live. In darkness, plants turn pale and die. In the sun their leaves are green and they make food and store it in the plants. In many cases, animals eat this plant food. Plants and animals, therefore, would die without sun. We human beings depend on the sun for almost everything.



How to find out if you are good at thinking out problems

Ask a grown-up to be your referee.

marks

1. Which of the following statements are true and which are false?
   Dandelion seeds have parachutes:
   (*a*) So that you can tell the time. (*b*) Because they like to fly.
   (*c*) Because they need to reach a place to grow in. 2
2. Which of the following are possible?
   (*a*) A swallow walking on the ground? (*b*) A green mushroom?
   (*c*) Flowers growing on a tree? (*d*) A purple plum? (*e*) A copper magnet? 5
3. How could you tell the difference between the footprints left in the sand:
   of a man, a boy, a girl, a horse, and a dog? 5
4. How many different things can you think of which a bird has and a dog has not? 5
5. How could you find out:
   (*a*) Which boy or girl in your class has the keenest hearing?
   (*b*) The heaviest child in your class (using a plank of wood and anything else you require)? 2
6. Which figures come next in the following:
   (*a*) 1 2 3 ? (*b*) 2 4 6 ? (*c*) 0 3 6 ? (*d*) 6 9 14 17 22? (*e*) 21 15 10 6 ? 5
7.

A	E	I	O	U	T	C	N	H	P
10	9	8	7	6	5	4	3	2	1

   TOP is 571. What is CAT? PAIN? 47635? 3
8. Some plants climb, some sting, some scratch. Can you explain? 3

30

How much have you learned this year? **Test three**

1. Match the two parts so that the sentence reads correctly:

Steel	are the remains of plants or animals preserved in rocks.
Magnets	is almost pure iron.
The sun's rays	will not attract silver or copper.
A seed	come to the earth in straight lines.
Fossils	contains the root and shoot of a plant.

2. Correct the following statements if you think they are wrong and re-write correctly in sentences:
   Ice is called hard water.
   A vibrating string makes a note.
   A poker can be made into a magnet.
   Fishes die in a pond which is frozen over because all the water freezes solid.

3. Write out and finish these sentences:
   Plants grow from ———, birds from ———, and butterflies from ———.
   The parts of a plant are ———.
   The sun is useful to us because ———.
   All living things require ———.
   Sound travels through ———.
   Magnets attract ———. They are used in ———.

4. A bird has different kinds of feathers. Why?

5. Draw four leaves which have different shapes. Put their names underneath them.

6. Write down as many names of white, red, pink, and yellow flowers as you can.

7. What makes things look bigger? Answer in a complete sentence.

8. Draw and label the different ways in which air gets into and out of a room.

9. Match the numbers with the letters:

    1. Humus
    2. Clay
    3. Iron
    4. Earthworms
    5. Wind
    6. Oxygen
    7. Experiments
    8. Light

    (*a*) is a metal which can be made into a magnet.
    (*b*) test to see if something works.
    (*c*) travels more quickly than sound.
    (*d*) is moving air.
    (*e*) is decayed leaves.
    (*f*) is an invisible gas in the air.
    (*g*) consists of very fine pieces of earth.
    (*h*) are animals which live in the ground.

10. How could you tell the speed of the wind?
11. What is an evergreen?
12. What are annual rings in a tree?
13. How do you take a bark rubbing?
14. How could you find out if the air in a mine or a well were safe?
15. Give one word which describes:
    (*a*) The yellow dust found on the stamens of flowers.
    (*b*) The part of the tree which is in the soil.
    (*c*) The next stage in the life of an insect after the larva.
    (*d*) What water is called when it changes into a gas.
    (*e*) The kind of thermometer used by the doctor.
    (*f*) The name given to sound which comes back again.
    (*g*) The carrying of pollen by bees from one flower to another flower.

Now that you have finished this book, re-read the page on *How to become a scientist.* It is on page 28.

Do you think you have gained all or any of the qualities we said would be necessary? Have you discovered if any of the records mentioned have been broken since this book was published?

We hope that you have enjoyed your Science topics and that you are now ready to go on next year to the second book, *The Junior Scientist.*